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ORGANIC NERVOUS DISEASE IN IDENTICAL TWINS*

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The study of identical twins has helped to elucidate many problems bearing on the influence of heredity and environment. When one reads in the literature the reports of case after case exemplifying the bond between identical twins in health and their morbid sympathy in disease, one can readily grasp the importance of inborn factors on mind and body.

DEFINITIONS

Bateson defines twins as "the production of equivalent structures by division. The process may affect the whole body of an animal or plant or certain of its parts." In other words, bilateral doubling in some degree is a necessary feature of twinning. If this is so, as will be discussed later, the term twin, as ordinarily used, a term which refers merely to the simultaneous birth of two individuals, is not biologically correct.

There are two kinds of twins: (1) Twins that are no more alike than any other two members of the same family. These may be of the same or different sexes, and are the result of the fertilization of two separate ova (zygotes). This type of twinning is called fraternal, bivitelline or dizygotic, and when twins, triplets, etc. are derived from two or more ova, the biologic features of the situation differ little from the ordinary phenomena of multiple births. (2) Twins that are so much alike that they are mistaken for each other, even by relatives. These twins are always of the same sex and arise from a single ovum (zygote) which ordinarily should have developed into a single individual. This type of twinning is called monozygotic, univitelline, homologous, duplicate or identical. According to Neumann's[1] estimation, one fourth of all human twins are monozygotic. Identical twins, then, represent biologically the only case of true twinning.

* Submitted for publication, July 24, 1928.
* Read at the Fifty-Fourth Annual Meeting of the American Neurological Association, Washington, D. C., May 1 to 3, 1928.

1. Neumann, H. H.: The Biology of Twins, Chicago, University of Chicago Press, 1917.

RECENT THEORIES

It may be of interest to review some of the recent theories of monozygotic twinning.

1. Schultz's theory. Two blastomeres separate completely and the two components remain in one zona pellucida and later become enclosed within one chorion. Schultz considers that double monsters are merely more or less incompletely separated twins and therefore fail to be fully developed. This early fission process of the two blastomeres, with the production of twin offspring, was observed by Loeb and one of us (J. M. W.) in experiments on the artificial parthenogenesis of the eggs of sea urchins. It was found that when the sea water used in the experiments was temporarily lacking in calcium, merely shaking the developing ova would almost invariably separate the blastomeres, causing the formation of two complete individuals instead of one.

Schultz's theory, no doubt, applies a fission process to the production of human uniovular twins but does not explain why or how it occurs.

2. Von Kölliker's theory. A single egg may occasionally produce two or more embryonic areas which may or may not develop separate amnions, depending on the juxtaposition of the two areas.

3. Bryce and Thacher's theory. Duplicate twins arise by some sort of early fission process, probably initiated in the ectoderm.

4. Wilder's theory.[2] Hereditary differentiation between twins can be traced back to events taking place during the first cleavage. This theory is more or less similar to that of Schultz.

5. Neumann's theory.[1] Duplicate twins become separated at some time prior to cleavage of the fertilized ovum, or there may be a division of the inner cell mass into the primordia of the two embryos.

Neumann's theory is based largely on the results of his embryologic studies on certain species of the armadillo, which always give birth to homologous quadruplets. He believes that these quadruplets become physiologically isolated at considerably later periods than do human twins, because the former have so much mirror-imaging in their armour, and the latter show so little. He considers, therefore, that the earlier the separation the more complete the reorganization of the symmetry relations in the separate individuals, and the less the residuum of the original common symmetry. Double monsters, Siamese twins, etc., begin therefore to separate comparatively late in ontogeny, and hence sometimes show pronounced mirror-imaging.

Neumann's theory is clearly the most comprehensive of all in view of his important comparative embryologic studies of twins in man and in other animals, in which twinning occurs either naturally or only

2. Wilder, H. H.: J. Hered. **10**:410, 1919.

sporadically. The ultimate proof of monozygotic twinning, as the same writer pointed out, must be the presence of only one true corpus luteum in the ovaries of the pregnant female, a criterion which in the case of human beings is difficult to verify except under unusual circumstances.

PHYSICAL AND MENTAL EQUIVALENCE IN HOMOLOGOUS TWINS

The extreme similarity of certain human twins to each other is strongly in favor of their uniovular origin. In fact, some of the twins in our series are so similar that such conditions as congenital absence of the upper lateral incisor teeth (fig. 7), and the presence of only one carious snag, the left first upper molar, are noted in each of one set. Another set is identical even to a birthmark in the right clavicular region. Each has a goiter of moderate size (fig. 9). The twins are of exactly the same height and weight, were mentally equivalent in school, have the same hobbies, and are in love with the same type of man (brunette).

Crowder, Laycock, Murray,[3] Abt[4] and many others commented on this physical and mental equivalence.

If twins arising from the same cell are so similar structurally as to appear "identical" one can reasonably deduce that they should be alike functionally, since similar structures could hardly have dissimilar functions. One must consider these twins, then, if Neumann's theory holds, biologically as only one individual, even though they are two individuals in practice, because they originated from the mother chromosomes of one zygote and therefore genetically should show an exact replica of inherited qualities. Furthermore, if structures such as the skin and teeth are identical, should there not be present identical brains which in turn should have identical patterns? If this is so the mental equipment at birth must, or rather ought to be, the same, the physiologic and metabolic activities of the brain should be identical, and therefore inborn traits, such as temperament, likes or dislikes, moods, capacity for assimilating, etc., should be more or less equivalent. In other words, identical twins are equipped at birth with identical structural and physiologic mechanisms which remain more or less constant throughout life, during which environment is only a minor source of difference in later development.

This conception, though not new, accounts for the various authentic descriptions of the remarkable unity of thought and action of identical twins in health as in disease even though they are at great distances from each other at the time.

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3. Murray: Lancet **208**:529, 1924.
4. Abt, I. A.: J. Iowa M. Soc. **14**:395, 1924.

Soukhanoff [5] said "L'organization physique semblable du système nerveux donne les troubles pathologiques identiques, et qu'il existe une dépendence réciproque et intime entre nos facultés mentales et la structure physique de notre organisme."

Abt [4] agreed with this assumption by declaring that "homologous twins usually show marked similarity physically, as well as mentally. Not rarely they show the same anomalies and faults of development. They may become sick at the same time, and may die almost at the same time."

Bleuler [6] reported the case of identical twin males who became sick at the same time, mentally ill also, even though they did not live together.

MENTAL DISEASE IN IDENTICAL TWINS

It is not easy to account for the same mental illness affecting identical twins at about the same time and evolving in the same way unless one accepts the doctrine of the inherent potentialities of certain types of mental disorder. Abt [7] quoted Schultz and Osteo to the effect that "the cause of psychoses in duplicate twins lies in the high-grade similarity in the structure of the brain so that psychic functions show a parallelism both physiologically and pathologically."

Soukhanoff [5] reported six cases of similar mental disease in homologous twins in support of his view "that the similarity of mental processes occurs in health as in the psychoses." He cited one case in which periods of normality occurred simultaneously even though the patients were in different asylums. Another pair developed the onset of a psychosis at the same time, and both committed suicide. Another pair exhibited, while in different places, the same manic symptoms with similar relapses and remissions. Soukhanoff concluded his excellent article with the concise statement that "on a observé une tableau d'une maladie plus ou moins identique chez tous les deux jumeaux."

As early as 1883, Savage [8] reported insanity in identical twins. Their histories were extraordinarily alike; both suffered from melancholia with stupor. Though they were housed in separate wards and had lived apart previously, during their confinement their conduct was similar.

In his experience, Parker [9] never found a single instance in which dementia praecox occurred in only one of identical twins. If it occurred at all, both were afflicted. He deduced from this that "the evidence is strongly in favor of a germinal source, arising from a germinal taint,

5. Soukhanoff: Arch. med. Psychol. **12**:214, 1900.
6. Bleuler: Text Book of Psychiatry, New York, 1927.
7. Abt, I. A.: New York State J. Med. **25**:511, 1925.
8. Savage: J. Ment. Sc. (Jan.) 1883, p. 539.
9. Parker, G. H.: J. Nerv. & Ment. Dis. **63**:135, 1925.

or maladjustment in the egg-cell, sperm-cell or both." Thus, the presence of the same mental disease in identical twins is strongly in favor of their being uniovular.

Halbertsma,[10] who had a wide experience with mongolism, is of the opinion that it also is of germinal origin and not acquired during intrauterine life. He argued that if twins are homologous "germinal affections will be equally present in both." As Parker [9] found in dementia praecox, so Halbertsma reported that "cases of twin mongols of different sex do not exist." In other words fraternal twins have never been found to be both affected with mongolism. He concluded that mongolism is due to the results of defects inherent in the germ plasm.

Strauch,[11] in a careful critical review of mongolism in twins, came to the same conclusion with the statement that "an endogenic factor exists in one of the gametes in the etiology of mongolism."

ORGANIC NERVOUS DISEASE IN IDENTICAL TWINS

The investigation of organic nervous disease in identical twins is of much interest and importance for various reasons: 1. It may help to substantiate the theory that the twinning process must occur at or before the time the ectoderm is differentiated, because the most important structures involved in that process arise from the ectoderm, viz., the nervous system, skin, teeth, hair, etc., while those structures arising from the mesoderm and endoderm are little if at all involved. Neumann [12] thought that the parts derived from the latter two layers are merely included in the process and take a minor share in it. 2. The central nervous system, being the most differentiated of all ectodermal structures, is liable to serious and evident defects from comparatively slight errors in ontogenesis. 3. If the concept is true that the functions to appear last in evolution are usually the first to be affected by disease, one can readily account for the large number of recorded cases of psychoses and mongolism in identical twins, because the psychic is the highest level of the central nervous system and the latest to be acquired.

There have been few published reports of cases of organic nervous disease in identical twins.

Toledo [13] reported a case of twin girls with epilepsy. The onset of the disease in one occurred within a few months of that in the other.

10. Halbertsma, T.: Mongolism in One of Twins and Etiology of Mongolism, Am. J. Dis. Child. **25**:350 (May) 1923.

11. Strauch, August: Mongolian Idiocy in Both Twins, J. A. M. A. **81**:2181 (Dec. 29) 1923.

12. Neumann, H. H.: The Physiology of Twinning, Chicago, University of Chicago Press, 1923.

13. Toledo, R. M.: J. Ment. Sc. **65**:262, 1919.

Both were feebleminded and finally they became insane within two months of each other. They showed the same symptomatology. Both girls menstruated at 13, and the menses ceased with the onset of delusions.

Hess [14] reported a case of Friedreich's ataxia in twin boys, aged 10 years, with a similar degree of ataxia, poor mentality, Romberg and Babinski signs, ataxic gait, absent knee and ankle reflexes and pes cavus. The family history was without significance.

Clouston and Savage [15] published the report of cases of paresis in twin men, aged 37, commercial travelers, who were infected probably at the same time and who died of the disease at about the same time.

Abt [7] reported a case of identical twin males with rickets, convulsions and tetany. This case is included in his series because of the indirect functional involvement of the higher levels of the central nervous system.

REPORT OF PERSONAL CASES

We are in a position to add four new cases of organic nervous disease in homologous twins to this sparse collection. Each set of twins in our series is suffering from a different, distinct and important type of nervous disease, and the mere variety of these nervous disorders may help to form some definite conclusions, or at least to confirm some of the theories previously advanced.

CASE 1.—*Congenital Nuclear Ophthalmoplegia in Identical Twins: Feeblemindedness.*

(These twins presented so much similarity in previous history and present status that one combined history will suffice for the two except in minor details which will be noted.)

History.—Violet and Marjory C., twin girls, aged 12 years (figs. 1 and 2), were the youngest of five children; two brothers and one sister were normal. The father was alive and well. The mother was neurasthenic, and had suffered from delusions of persecution. A maternal aunt had seven children, all normal, the last two of which were fraternal twins (boy and girl). Another maternal aunt was left handed. A history of other forebears was not obtainable. The patients are the youngest of five children; two brothers and one sister are normal. There was no alcoholism, syphilis or disease similar to that of the patients in the family.

The patients were born at term normally. Before and during the pregnancy the mother was "much run down physically" and later was unable to feed them at the breast. From birth it was noted that they were weak. "They did not open their eyes for the first three days and then only very little." They developed mentally only slightly and had never been able to speak. In infancy both suffered from malnutrition and walked for the first time at the age of 4. Both girls had developed mentally and physically pari passu and appeared so much alike that they were almost identical (fig. 1). Neither could talk except in monosyllables (one called her sister Marjory "Ma," and herself "Va," and vice versa). In November,

14. Hess, J. H.: M. Clin. N. Amer. **5**:1749, 1922.

15. Clouston and Savage: J. Ment. Sc. **34**:65 (April) 1888.

1927, an instructor reported that they were "getting to know written symbols; can say numbers to five." Both appeared physically well except for the congenital deformity to be described.

Physical Examination.—Positive Observations: Both were undersized and underdeveloped, were low grade imbeciles and could carry out only the simplest

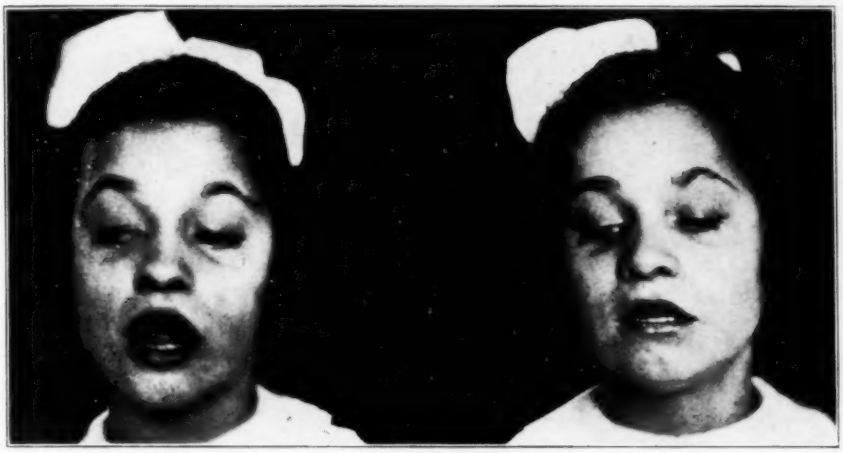

Fig. 1.—Violet and Marjory (case 1), homologous twins.

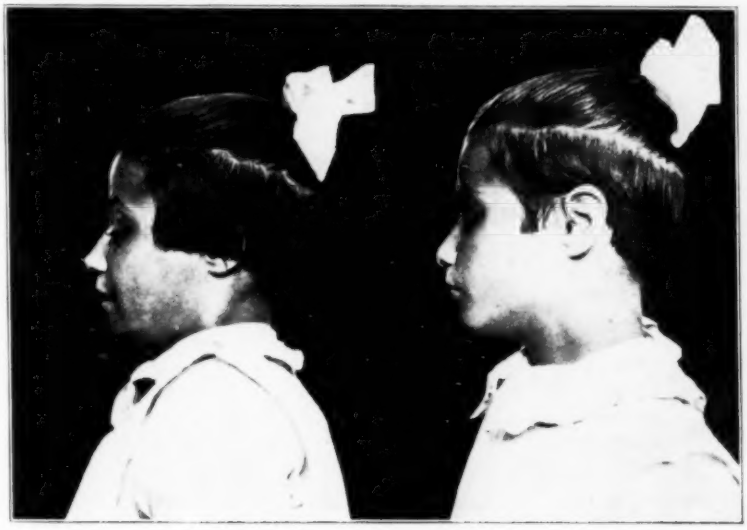

Fig. 2.—Violet and Marjory (case 1), homologous twins.

orders. Both had happy dispositions and were clean in their habits. Both were right handed.

There was an obvious, marked, double ptosis, which caused the patients to bend the head far backward in their efforts to look upward. The mouths were held

partly open (less so in the case of Marjory). Marjory's tongue was a little longer and thinner than that of her sister.

The cranial nerves were normal except for the abnormalities noted. The pupils were equal, reacted to light and were slightly eccentric. The disks and sight were normal. There was a marked double ptosis with overaction of the frontalis muscles. No upward or downward movement of the eyeballs could be elicited. When the patients looked to the right and to the left, the separate lateral movements of each eye were fairly performed, but conjugate movements were poor. There was no movement of convergence of the two eyes. On relaxation the eyes assumed a downward and outward position.

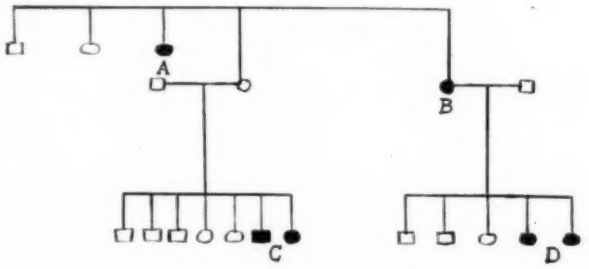

Fig. 3.—Heredity chart (case 1); *A*, left handed; *B*, nervous delusions; *C*, fraternal twins; *D*, patients.

Fig. 4.—Finger prints (left thumb): *A*, Violet; *B*, Marjory.

The deep and superficial reflexes were active and equal on the two sides. The plantar reflexes were equivocal (no cooperation). There was no clonus.

The sensations were essentially normal for cottonwool and pin prick.

The gait was spastic. They walked with the feet slightly inverted. The movements of the legs showed slight spastic rigidity. There were no atrophies or paralyses. All four extremities were rather thin. There was neither tremor nor ataxia. The grip was fair on both sides. The hands and feet were cyanotic. Onychophagia was present. The skin was pigmented (brunette type). The color of the iris was brown.

Laboratory Observations.—The blood and urine were normal. The Wassermann reaction of the blood was negative. The finger prints (fig. 4) were of the same pattern, the whorl type, though the number of ridges in each pattern was different.

CASE 2.—*Cerebral Diplegia in Identical Twins; Feeblemindedness.*

History.—John and James C., were 21 years of age (fig. 5). The father was living and well. The mother was living and had had "fits" until 12 years of age; she had had only occasional "faints" since. An older sister had died of diphtheria at the age of 7. There were no other siblings. The mother had not had any miscarriages. A maternal grand-aunt had had fraternal twins (boy and girl). The mother had five brothers and four sisters—no twins. There were no twins on the father's side of the family. A paternal aunt—delicate—had "a similar disease to what the boys have, and can read and write after a fashion." A maternal uncle was insane and had fits.

Fig. 5.—John and James (case 2), homologous twins.

The patients were full-term infants and were nursed at the breast for one month; cow's milk was fed after this. They walked at the age of 2 years, rather clumsily. It was noticed early that they were backward mentally. They went to school from the ages of 7 to 10 and then left because they could not learn. Both had had chicken-pox at 3 years and had had no other infectious diseases. The twins had always been together—played together, and at the time of writing even shaved together. There was no history of "fits" or "spells." Both were clean in their habits.

Physical Examination.—There was a marked similarity of physical appearance, although James looked a little brighter than John. Both were of the same height and weight. The iris pigmentation was the same. Both had happy temperaments although John was slightly more excitable and demonstrative. Neither deformities of the head nor spina bifida was present. There was congenital absence

of the upper lateral incisors in each (fig. 7). Only one carious snag was present—the left first upper molar of each denture.

The voices were of a similar explosive character.

The cranial nerves were normal. The disks were clear; the pupils were regular and equal and reacted actively to light and in accommodation. There were no nystagmus or ocular palsies.

The biceps, triceps, radial, knee and ankle reflexes were hyperactive; the abdominal reflexes were diminished and equal. The plantar reflexes were in dorsiflexion.

The gait was characteristic of spastic paraplegia.

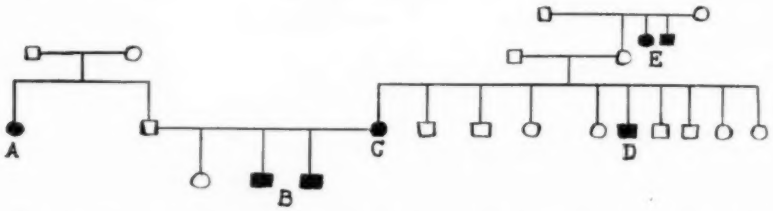

Fig. 6.—Heredity chart (case 2); *A*, disease similar to that in patients, feeble-minded; *B*, patients; *C*, fits; *D*, fits, insanity; *E*, fraternal twins.

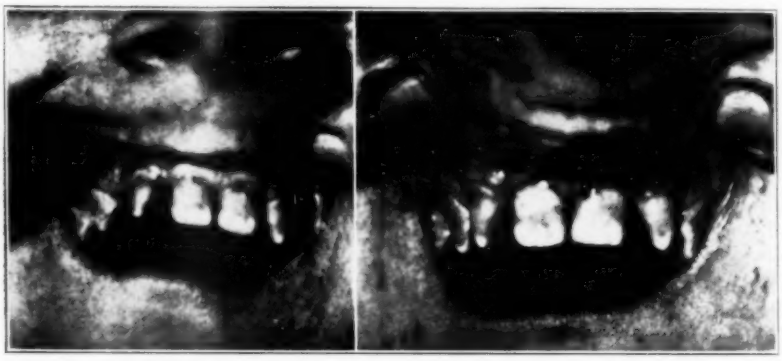

Fig. 7.—Presence of only one carious snag, the upper left molar of each denture (case 2).

Laboratory Observations.—The blood and urine were normal. The Wassermann reaction of the blood was negative.

The mental age of both, by the Binet-Simon tests, measured 3½ years.

The left thumb prints of each were of the same type—loop pattern (fig. 8).

CASE 3.—*Epilepsy in Identical Twins.*

History.—(1) Edith S., aged 22 (fig. 9), complained of convulsions. The father and mother were living and well. There was no history of fits in the immediate family, nor of alcoholism or mental disease. The paternal grandfather had senile epilepsy. Paternal uncles were "twins"; likewise, maternal second cousins were identical twins. The patient is one of homologous twins. The mother had had no other children and no miscarriages.

The patient was born and developed normally. At 3 months she had suffered from "shivering fits," which recurred frequently till the age of 9 years. In these spells she would "get cold" and shake from head to foot. During the spell she was unconscious and would go to sleep after it was finished. She had had pertussis at 5, measles at 6, diphtheria at 8½, and scarlet fever at 9 years. She was always bright, cheerful and optimistic. She reached the seventh standard at 13 years. Otherwise, the past history was unimportant.

At 9 years of age, a few months after having had diphtheria, the patient had a generalized convulsion. These convulsions recurred every three months at first and became gradually more frequent. She had minor attacks also, in which she felt giddy, sometimes with and sometimes without tinnitus, and a feeling of strangeness in which she momentarily did not know where she was. The patient said that she could occasionally abort a major attack by using her "strength of will." The major attacks were always the same and were always preceded by giddiness and queer feelings. She had had loss of sphincter control during the

Fig. 8.—Finger prints (left thumb); *A*, John; *B*, James.

attacks and had bitten her tongue, especially on the right side, each time. There was no history of headaches, nausea or vomiting. Worry or severe emotion would precipitate an attack.

Physical Examination.—The patient was 5 feet 3 inches (160 cm.) in height and weighed 107⅛ pounds (48.6 Kg.). A moderately large, simple goiter was present (fig. 9); the patient said that a similar mass was present in her maternal grandmother also. The palate was high arched.

Neurologic Examination.—This gave negative results throughout.

Laboratory Observations.—The blood and urine were normal. The Wassermann reaction of the blood was negative.

History.—(*2*) Elsie S. also complained of fits. She and her sister Edith looked so much alike that they could not be told apart (fig. 9). The sisters used to play pranks with success, using their similarity as the basis of the prank. Both girls were right handed. Both attended the same school, were in the same classes, and attained practically the same marks. They graduated together. Both menstruated at 13 years within a fortnight of each other. Both were in love with the same type of man (brunette). They had had pertussis and measles together, but Elsie did not

suffer from diphtheria or scarlet fever, which her sister had, although she was exposed to both diseases.

This patient had had her first fit at 13½ years. She had the same "warning" as the sister—vertigo, tinnitus and strange feelings. The attacks were major epileptic, occurring every five months at first and later at more frequent intervals. There was no history of shivering fits, nor of minor attacks in infancy.

Physical Examination.—This patient was like the sister in height, weight and general appearance, even to the color of the iris (gray blue), enlarged thyroid, high arched palate and position of a congenital pigmented nevus in the right clavicular region. There was no neurologic evidence of gross nervous disorder. The results of laboratory tests were similar to those in the sister.

Fig. 9.—Edith and Elsie (case 3), homologous twins.

CASE 4.—*Diabetes and Acute Apoplexy in Identical Twins.*

History.—Mrs. L. G. and Mrs. B. were twins. There were no other twins in the immediate or remote family. Throughout life these patients had similar temperaments and looked so much alike that members of the family could not tell which one they were addressing. Mrs. G. lived in San Francisco; Mrs. B. lived in New York. At the age of 52, both developed the same degree of diabetes mellitus which was kept under control with equal facility. At the age of 59, Mrs. G. died of acute cerebral hemorrhage. Mrs. B. died some time later under identical circumstances. (These cases are here recorded through the courtesy of Dr. Lawrence Hoffman of San Francisco.)

COMMENT

The cases of homologous twins described in this paper present the remarkable structural similarities so often previously described. We have emphasized the minuteness of structural alikeness even to the finger prints, which in a given pair of homologous twins in our series conform to the same type, although the number of ridges making up the pattern is slightly different in each set. These structural similarities not only were not limited to normal structure, but included various congenital and acquired anomalies, e.g., the congenital absence of the upper lateral incisors and also the presence of only one carious snag—the left upper first premolar decayed to the gingival margin in one set of twins. In another set, there was similarity of position, size and structure of a congenital nevus, a high arched palate, and the presence of goiters of the same size.

We have examined our patients for mirror-imaging of external and internal structures, but have found these to be conspicuously absent.

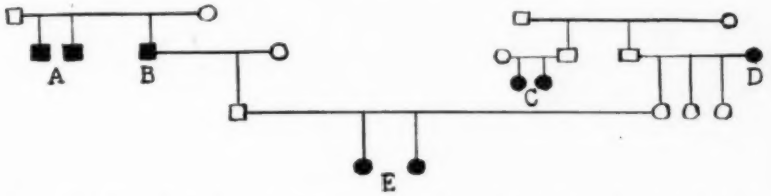

Fig. 10.—Heredity chart (case 3); *A*, twins; *B*, senile epilepsy; *C*, twins; *D*, goiter; *E*, patients.

We believe therefore that since homologous twins are the result of cleavage of the fertilized ovum in the earliest stages of development, resulting in the formation of two individuals instead of one, the cells of each twin are endowed with daughter chromosomes of the original combined male and female gametes which must have one and the same inherent structural and physiologic potentialities; furthermore, the functions of organs, especially those of the central and vegetative nervous systems, should show similar capacities and deviations.

In this series, each pair of twins showed a striking equivalence in mental endowment, which ranged from normal (cases 3 and 4) to low grade imbecility (cases 1 and 2).

These cases seem to indicate that if structural and functional disease of the nervous system occurs, it affects both twins equally, and not one twin alone. This is true of our cases with organic nervous disease—epilepsy, congenital nuclear ophthalmoplegia and infantile cerebral palsy.

May not the presence of epilepsy in identical twins serve to strengthen the belief that idiopathic epilepsy has, at least in some cases, a congenital origin?

An observation worthy of note was revealed in the family history of the twins with cerebral diplegia, in which there was the interesting combination of the presence of another case of cerebral diplegia in the paternal ancestry and the occurrence of twinning on the maternal side.

Homologous and fraternal twinning occurred in the families of three of the four sets of twins.

CONCLUSIONS

1. In health, homologous twins show a striking similarity of structural, functional and mental equipment.

2. When organic nervous disease occurs in homologous twins, it is most probably the result of inherent defects and is always present in both twins.

3. The same obtains for the presence of anomalies and deformities in identical twins.

4. An anomaly of development is always similar and equivalent in both homologous twins.

5. Biologically considered, homologous twins are only one individual; physically they are two.

PSYCHOLOGIC COMPONENTS IN POSTENCEPHALITIC OCULOGYRIC CRISES

CONTRIBUTION TO A GENETIC INTERPRETATION OF COMPULSION PHENOMENA *

SMITH ELY JELLIFFE, M.D., PH.D.
NEW YORK

I feel justified in presenting at the outset of this paper the abstract prepared and read at the meeting of the American Neurological Association in 1928. This outlines the scope of the complete study, which by reason of its bulk cannot be published in the periodic literature, and may be offered in monograph form later.

Following this abstract it is my intention to include here but one chapter in this more extended study. The chapter on "phenomenology" has been selected for presentation from four case histories, to be followed by a general consideration of the phenomena observed in the accompaniments of chronic parkinsonian encephalitis, so far as oculogyric crises are concerned. In this, a detailed picture derived from personal observation and interpretative meaning of the 200 cases reported in the literature will be sketched.

Emphasis is put on the "dissolution of function" conceptions of evolutionally oriented points of view, notably those of Hughlings Jackson for the earlier period of study, and then those of von Monakow, Kretschmer and Goldstein in the present era. It cannot be too emphatically pointed out that lip service is all too frequently rendered to Jackson's conceptions, and their real implications are neglected. So far as the "body as a whole," at all of its levels, including the primitive psychologic-social level is concerned, they are ignored. Most of the authors who quote Jackson think in terms of "motor" levels only; they rarely envisage the fact of primitive social impulses at lower levels of expression in terms of instinctive ego and libido strivings. For the most part, they show a singular inability to look at man as behaving in terms of purposeful patterns. Thus, one reads of striatal pathology as facilitating "hysteriform suggestibility" (C. and O. Vogt, and others), as if this really meant anything more than two words. This is mentioned here, since this exposition of the thesis must be found elsewhere.

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* Submitted for publication, June 18, 1928.

* This present thesis will thus include the abstract, then brief summaries.

* Read in abstract at the Fifty-Fourth Annual Meeting of the American Neurological Association, Washington, D. C., May 1, 1928.

ABSTRACT OF COMPLETE STUDY

A résumé of the abstract follows:

Historical introduction concerning spasmodic eye movements found in the earlier literature, there classified as tics, spasms, epileptiform cramps, etc. (Crouzon,[1] Babinski,[2] Meige, P. Marie,[3] and others). Comments on their occurrence in earlier influenza epidemics (Leichtenstein). Complete digest of special studies from 1921, as seen following epidemic encephalitis. Brief summaries of these cases are reported early by Oeckinghaus[4] and G. Lévy[5] and the later cases to 1928. Personal case reports. Special consideration of the views of Bing,[6] Wimmer[7] and Stern[8] relative to somatogenesis and psychogenesis, and efforts at offering a monistic rather than a parallelistic interpretation of somatic and psychogenic pathology. Detailed analysis of the genesis of a case of postencephalitic oculogyric crises as a compulsion neurotic manifestation, with comments on a humanistic interpretation of the phyletic sources of the sense of guilt and its relations to primitive religious anticipation of scientific biologic principles of ethical behavior.

Before proceeding to any discussion of these eye phenomena, it seems imperative that attention be called to one important consideration. The studies of Sherrington, Magnus, de Kleijn, Goldstein, Foerster, Zingerle[9] and others have shown clearly that there are practically no isolated reflex body position movements. Thus the oculogyric crises which have been chosen for special study cannot be dismembered, except for hypothetic purposes, from other synergistic movements, such as those of position, righting, head and speech and those that are psychic. The integration of the nervous system is such that with these eye movements a whole series of synergisms is necessitated.

In my descriptive summaries these have been searched for, but in the various outlines of the crises different observers have given but few details of the bodily positions, and even fewer have paid attention to

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1. Crouzon, O.: Tic d'élévation des deux yeux, Rev. neurol. **8**: 54, 1900.

2. Babinski: Rev. neurol. **8**:525, 1900.

3. Marie, P.: Rev. neurol. **9**:428, 1901.

4. Oeckinghaus: Encephalitis epidemica und Wilsonsches Krankheitsbild, Deutsche Ztschr. f. Nervenh. **72**:294, 1921.

5. Lévy, G.: Manifestations tardive de l'encéphalite épidémique, Thése de Paris, 1922, p. 54.

6. Bing, R.: Ueber lokale Muskelspasmen und Tics nebst Bemerkungen zur Revision des Begriffes der Psychogenie, Schweiz. med. Wchnschr. **55**:50, 1925.

7. Wimmer: Chronic Epidemic Encephalitis from Medicolegal Standpoint, Hospitalstid. **67**:177, 1924; Tonic Eye Fits: Oculogyric Crises in Chronic Epidemic Encephalitis, Acta psychiat. et neurol. **1**:173, 1926; Chronic Encephalitis, London, William Heinemann, 1926.

8. Stern: Ueber psychische Zwangsvorgänge und ihre Entstehung bei encephalitischen Blickkrämpfen mit Bemerkungen über die Genese der encephalitischen Blickkrämpfe, Arch. f. Psychiat. **81**:522, 1927.

9. Zingerle: Ztschr. f. d. ges. Neurol. u. Psychiat. **99**:18, 1925.

the mental content of the compulsive acts or thinking. Thus, if it has seemed that one has been inclined to think of these oculogyric crises as isolated phenomena it is to be remembered that this is not the case, and that the organism, as a whole, is being seen in the background at all levels of its adaptive capacity, vegetative, sensorimotor and symbolic. Economy of time necessitates omission of consideration of the entire situation. Under present medical ideals of observation a thorough portrayal of a single attack could, if needs be, fill a volume. Medicine, as in other disciplines, is in the dangerous position in that too much can be learned about any one thing for it to be completely synthesized. Hence, the many incomplete generalizations which, like piles of rubbish crowding its broad highway, hamper medical thinking at every step of its progress. One can readily conjure up the vision of innumerable rag pickers busy with thousands of rubbish heaps of old generalizations. Such little hoards of questionable observations clutter the pages of medical literature. The present communication cannot hope to escape entirely from some of this uncomfortable situation.

When I started this study of the interactionism between oculocephalogyric crises and mental phenomena I shared the illusion with at least three score and ten other observers that I might make something out of it of value to others. But, as in other inquiries into the mysteries of Nature, the more I delved the more obscure became the relationships I had hoped to elucidate.

Surely here again was to be found that situation of the specialist who "learns more and more about less and less," and its accompanying and inevitable layman's opposite of "knowing less and less about more and more." Therefore, I have come to the simple expedient of exposing the skeleton of my activities and leaving it for cogitation. I can only say what my paper, now swollen beyond all reasonable limits, attempts to encompass.

First, it reviews the phenomena of the oculogyric crises seen in chronic epidemic encephalitis by a conscientious digest of practically all of the available literature from 1695 to the present date. The year 1695 is mentioned since J. P. Albrecht of Hildesheim wrote a pamphlet on "Epidemic Lethargy and Ocular Symptoms," clearly indicating that the general situation was not unobserved even at that early date.

Albrecht [10] wrote:

> In the year 1695, a maiden of this place, about 20 years old, daughter of the honest citizen I. F., fell into a continued fever, characterized by acute headache, dryness of the mouth and other symptoms usually noted in maladies of this kind, of which, in this subject, the most notable was an extraordinary propensity to

10. This is taken from the Latin in Crookshank's volume on "Influenza" Heinemann, 1922; and translated for me by Dr. F. H. Garrison.

sleep; which, in proportion as the headache remitted, became more and more pronounced, in such wise that as often as the patient was awakened the relapse into slumber was the more profound. In the period of temporary improvement of health, there was plainly noted a distortion of the eyes, which propelled the pupil toward the upper eyelid, showing the white of the whole half of the lower eyeball.

Then I pass by a great leap to the Charcot era. The historian could find much of value in the interval of 250 years. I only touch a few high spots. In one of Charcot's "Leçons du Mardi," one finds the fascinating account of an early parkinsonian Bachère.[11]

The problem of eye movement tics as envisaged by Brissaud and his pupils Meige and Feindel, and the study of Cruchet are briefly touched on. The related phenomena seen in the pandemic of influenza in 1889 and 1890 are also mentioned. A number of observers had seen these oculogyric crises in some of the so-called organic, as well as the so-called functional, situations. Thus, in 1884, Nothnagel saw related phenomena. In 1895, Vorkastner observed them in a case of presenile paralysis agitans. And cases of epilepsy, syphilis, tumor of the brain, cerebral abscess, hemiplegia, general paresis and similar conditions were known to have presented the phenomena under consideration as seen from a clinical angle.

Then came the deluge of the postencephalitic cases after von Economo's important study. In 1921, Oeckinghaus [4] related the earliest case here found directly related to encephalitis. Staehelin [12] is frequently cited as having reported the first case, but after reading his paper carefully I feel that his case was a prelethal convulsive seizure with well known eye movements and does not belong here.[13] Then Gabrielle Lévy,[5] in her magnificent thesis, reported two excellent case histories. My reading of these cases does not entirely correspond to that of Roger and Reboul-Lachaux.[14] From then on, as herein noted, three score and ten and more have occupied themselves with the problems presented, and nearly 200 case histories are here represented. Lubrano,[15] in his thesis, the first one of its kind, collected about forty-six cases of this type.

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11. Charcot: Leçons du Mardi a la Salpêtrière, ed. 2, 1892, p. 331.

12. Staehelin, J.: Schweiz. med. Wchnschr., 1920, p. 201.

13. A personal communication from Professor Staehelin confirms my thought on this subject.

14. Roger, and Reboul-Lachaux: Spasmes toniques oculogyres des droits supérieur et aphonie intermittente chez un parkinsonienne postencéphalitique, Rev. d'oto-neuro-ocul. **3**:684, 1925; Spasmes à bascule des oculogyres au cours d'un syndrome parkinsonien postencéphalitique. Crises associeés de deviation conjugée des yeux à droite et à gauche, Rev. d'oto-neuro-ocul. **4**:689, 1926.

15. Lubrano: Contribution a l'étude des spasmes oculaires au cours de l'encéphalite épidémique, Thése Montpellier, 1926.

The kind of oculocephalogyric crises that follow in the wake of epidemic encephalitis, while standing out as striking and apparently isolated phenomena, are really but parts of a much enlarged general picture with which neurologists are familiar. This is the general hypertonic or hyperkinetic, dyskinetic picture—the amyostatic syndrome of Strümpell—out of which the oculogyric crises are artificially dismembered and intensively studied.

Most observers of these postencephalitic oculocephalogyric crises have emphasized the rarity of these syndromes; on the other hand, Stern spoke of their frequency. As an example, Bing, in 1926, wrote that he had seen only three in 300 cases. In as many cases, Wimmer

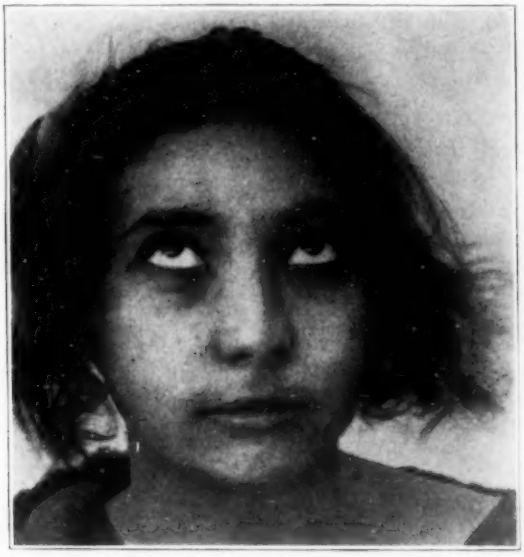

Fig. 1.—First illustration of case of oculogyric crisis, Rossi.

had but five to report, whereas Stern found twenty in 100 of his cases. In the present paper I do not offer statistics as I have seen most of the great number of cases I have observed in the clinics of Europe and the United States. In the past year, however, I have seen four cases in private consultation work, two of which have been studied intensively. These are to be found in the complete paper.

Holding the belief that even one case investigated in great detail is of far greater value than 100 less intensively studied, the question of numbers is of secondary value from the standpoint of the present study.

Practically all of the cases summarized in this study have been in chronic encephalitic parkinsonism. For the most part, the ocular situa-

tions come on late in the progress of the disorder. Vivaldo [16] is practically the only one who speaks of the development of the crises simultaneously with the acute stages of the encephalitis. A few have occurred within a year after the acute infection, but the majority have occurred from two to four or more years after the acute disorder. Wimmer reported one case occurring as late as seven years after this disorder. The first oculogyric crises in one of my cases occurred nearly six years after the encephalitis.

The main outstanding feature is a paroxysmal spasmodic conjugate deviation of the eyeballs, most frequently upward and to the right, but also directly vertical, to the left, or even rarely downward to the right or left. In the greater number of the cases, there is a period in the attack when direct forward staring is observed. This is usually at the beginning, and not infrequently is the most commonly observed feature. One feature is to be emphasized. This is that a great amount of variability in the direction taken by this fixed eye position, not only during an individual attack but in different attacks, is observable. Thus, ambitendent (Bleuler) positions are not rarely observed: up and down—right and left; up and to the right, down and to the left, etc.

Throughout the entire range of the recorded cases—i. e., when the records are at all complete—trance-like states are obvious. These shade off into tetanoid, epileptoid, narcoleptic, cataleptic, catatonic or closely related states, with varying intermediary stages of consciousness from full vigilance to complete psychic blocking or even to unconsciousness.

The states may appear frequently, several a day, or rarely, once a month, or at even longer intervals; also at regular or irregular intervals. Most often the records indicate a heaping up of attacks late in the day. By most authors this is referred to fatigue, since in many instances prolonged muscular efforts seemed to precipitate an attack. Even more important than a series of concomitant precipitating factors, such as lights, sounds, smells and other factors, emotional factors stand out most prominently in leading in some manner to an attack.

The attacks may last a few minutes or they may persist two or three days. The same patient will show these variations in the time interval in different attacks; other patients show a more or less stereotyped length of attack. The only valid generalization seems to be that no generalization is valid. Thus Roger and Reboul-Lachaux's efforts at classification are here regarded as but a temporary expedient of questionable value.

16. Vivaldo: Prensa méd. argent., 1926, vol. 12; Rev. d. criminol. psiquiat. **13**:280, 1926.

In most cases the attack comes on suddenly; in some, the patients work up through a cycle until a most complicated series of synergic hypertonic torsion states of progressive reciprocal innervation patterns are developed (see Zingerle-Gamper and Untersteiner for related hypertonic states). For the most part, however, the pattern is a comparatively restricted one. Thus, Wimmer reported strictly isolated oculogyric states. However, as already indicated in the opening paragraphs of this paper, the ocular spasm is but a part of a complicated generalized tonic effort. Most of the cases show an oculocephalogyric combination. The abstracts show a great variety of facial, masticatory, swallowing, speech, respiratory, arm, leg, bodily torsion and menagery movement accompaniments.

There are frequent sensory occurrences. The eye movements are often painful—"Jesusly painful" one of the author's patients stated; they are felt in the eyes and in the back of the head mainly.

The most important subjective state recorded, and the one on which I shall concentrate attention is that of great anxiety. This, with the blocking of thought, stands out in the inner life of these patients and lies at the heart of the psychomotor phenomena, i. e., the "compulsive state."

This affective situation of great anxiety sometimes breaks through as hallucinatory projections, or, through conversion of emotional discharges, at chemical and other levels and almost invariably invades the general psychic orientation. Suicidal compulsions are not unknown, and a few of these patients have attempted and even accomplished suicide, so deep does the anxiety regress to the death wish. Wimmer (case 3) spoke of his patient as having the impression of "being told by his eyes" to commit suicide, and, even obeying on some occasions these "imperative hallucinations." Two patients here described had made suicidal attempts before observation and one during the time of observation.

The inner blocking of thought—stickiness of thought— is also discussed in this paper. As a broad generalization, since "thinking" may profitably be conceived as but an inner mechanism of motion, this thought blocking is distinctly homologous with the general motor rigidity now so extensively studied in parkinsonism.

Hypotheses of localizations (plural be it emphasized) are also discussed, always under the implication of Hughlings Jackson's fruitful conception of the dissolution of function to lower levels of structure. Some authors mention this, but seem not to be oriented to what Hughlings Jackson meant. Lower levels to them are only motor levels and not psychic levels of instinctive behavior as purposeful in a biologic sense. As in a previous study of the respiratory manifestations, two years ago, the idea is emphasized that the phenomena are related as

much to the positive as to the negative situation. The individual delivers his ancestral pattern impulses as best he can (positive symptoms), more with the well parts of the machine, whereas the (negative) signs are related to the actually disordered bits of the neural machinery. These important structures (telencephalic mostly?) being out of commission—more or less temporarily or permanently—limit the discharge (always under varying intensities) and thus crowd the available pathways. Just what this has to do with the "anxiety" situation is the main line of the thesis and the justification for dragging in ethical precipitates of conduct control under the broad caption of "the sense of guilt."

This thesis emphasizes the futility of guiding the hearer through the maze of studies, now some 150 years in the making, into the complicated problems of forced conjugate deviation of the eyes, head and other associated movements. Magendie's early studies initiated these. There are numerous guides far better qualified to point out the chief inroads on ignorance of the anatomy, physiology and pathology of the organic substratum involved in these phenomena. Spiller (1905 to 1919) started such orientations, and Muskens, of Amsterdam, has done conscientious service in this direction. The historically interested are referred to his studies,[17] particularly with reference to those types of conjugate deviation of the head and eyes arising from lesions of the ascending vestibular pathways in the posterior longitudinal fasciculus. Bing and Schwarz,[18] Marinesco[19] and others speak of irritative lesions of the posterior longitudinal fasciculus acting through striatal nervous units as causing these positive symptoms. This, I believe, is highly speculative.

As no single brain of a patient showing these phenomena in any outstanding manner has been subjected to any, much less a complete, study, one must fall back on hypothetic postulates for the negative symptom side of the problem of localizations.

The cortical centers of deviate conjugation movements are held by some to be responsible. This may satisfy those in favor of the epileptoidist theory.

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17. Muskens, L. J. J.: L'Influence du labyrinthe sur les mouvements de l'oeil. Le méchanisme de la deviation conjugée, Encéphale **21**:370, 1926; Nederl. Tijdschr. v. Geneesk. **11**:737, 1927; Les troubles vestibulaires supranucléaires postencéphalitiques, Rev. neurol. **2**:155, 1927; Central Connections of the Vestibular Nuclei with the Corpus Striatum, and Their Significance for Ocular Movements and for Locomotion, Brain **45**:454, 1922.

18. Bing and Schwartz: Les crises oculogyres verticales du parkinsonisme postencéphalitique, Encéphale **20**:150, 1925.

19. Marinesco: Les rapports des crises de déviation conjugée paroxystique postencéphalitique avec la contracture hystérique, Semana méd. **1**:630, 1926.

Two years ago, in my study of respiratory phenomena, the thalamic overresponse hypothesis (Head and Holmes) was utilized. The plastic emotional causative situations play into this hypothesis.

Most of the discussions here reviewed deal with the striatal substrata—thus, the hypertonic spasms (extrapyramidal epilepsies of Sterling,[20] Paulian [21] and Zingerle). The "neostriatum" is especially attacked since it has been the mode to refer those conditions of encephalitic hyperkinesia to neostriatal lesions. The authors who follow this lead are cited following C. and O. Vogt's conceptions of a segmental topographic representation of the body muscles in the striatal ganglia. I also add Wilson's stringent criticism about this, to him, premature generalization. Wimmer reported in extenso a case which seems to help this hypothesis.

Then, since the Magnus-de Kleijn studies have shown the great significance of the vestibular synergic apparatus, the records show many cases (van Bogaert, and others) of hypersensitivity to the vestibular tests. Again, direct cerebellar involvement, as cited in a case by Wimmer, offers some help in this chase of hypotheses. In a vertical oculocephalogyric case, Paulian pointed out its resemblance to "vermis cerebelli"—"Jackson's cerebellar fits"—involvement.

These are the chief hypotheses here reviewed as to the negative side of the problem as regards direct injury to the organismic machinery. Where there are so many localizations it is evident that there is poor comprehension of the cerebral mechanics.

However, as direct injury leads to "loss of function" and hence must be seen in a negative sense, attention is briefly focused on the positive side and inquiry is directed toward the purposeful pattern, if any, of the symptomatology. Here the difficulties are even greater than any heretofore encountered. Phyletic synthesis of structure, for the most part, has an optically observable basis. Comparative anatomy helps somewhat, and Tilney and Casamajor's effort at unravelling behavior by the myelogenic method under experimental conditions offers some insight into the complicated behavior reactions, even in the cat—so far removed from man.

What can be done in the realm of abstractions of a higher order than optically demonstrable patterns?

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20. Sterling: Rev. neurol. **2**:484, 1924.

21. Paulian, Demetre and Grigoresco: Rev. neurol. **29**:1403, 1922; Déviation de la tête et des yeux apparaissant par crises en même temps que paralysie faciale périphérique opposé, Rev. neurol. **2**:93, 1926; ibid., Encéphale **21**:275, 1926; Troubles oculaires paradoxicale au cours des séquelles de l'encéphalite épidémique et surtout au parkinsonisme, Rev. neurol. **1**:457, 1925; ibid., Paris méd. **85**:1394, 1925.

Sir James Fraser wrote a work of twelve volumes entitled the "Golden Bough." In the introduction to this work he spoke of it as a small contribution to the study of "ethics." This work offers an insight into multitudinous behavioristic formulas pursued by mankind in his primitive, early cultural, and later socialized activities. Running throughout this entire account, and in all others dealing with related ethnologic and anthropologic activities, ritual, as a fixed compulsive situation, stands out as a magnetic pole. The essence of ritual is compulsion, and the present thesis thus demands that any compulsion, seen from Jackson's positive aspect, must gather into its comprehension the ethical significance of a bit of behavior, whether it shows in the religious ritual of the "mass, or communion," in a "prayer wheel," "beads" or in a "tic." Thus an oculogyric crisis, i.e., a compulsive activity, contains a bit of ritual; how much the present study does not pretend to say.

A compulsion is a substitution phenomenon. The various authors, and there are many, who speak of a "tic" as hysterical, simply do not know their "onions," to use an Americanism. Practically all compulsions are accompanied by "anxiety," i.e., chiefly if the outlet utilized is interfered with. This leads the inquiry into the "maze" of anxiety.

The tight rope walker in the circus who gets a cold in the head with slight vestibular hyperemia passes up his act, as does also the trick bicycle rider. They will not risk the "anxiety" conditioned by their hypovestibular capacity. Perhaps this enters as one of a number of components into the anxiety of some of the oculogyric crises at the jacksonian elementary physical level (Hermann, Feder). Many a person with a compulsion neurosis fears he will fall. Cardiac disorder causes anxiety at another level. So on up at various levels from the fear attending physical maladaption to that of chemical disintegration, to biologic fault or finally to social exclusion, anxiety arises.

To illustrate by a concrete instance, a short time ago—unwisely perhaps—I discussed with an encephalitic patient and his brother the possible value of the utilization of a chemical procedure to cut short what might be a chronic or subchronic infection—following Wimmer's well known conception of chronic encephalitis. Immediately my patient started in on an oculogyric attack. It was dark, or I would have taken a cinematograph of his attack. He went into a typical trance state with upward deviations of the eyes and great anxiety. "My mind has a million thoughts," he said, as he gradually tied up into a typical parkinsonian attitude. They really were only a few—but "rape my sister, rape my mother; kill my brother, kill my father" were the actual thoughts that he whispered.

In the records of the cases gathered in this paper, there are a number of definite indications of the emergence of related primitive

impulses; primitive in the sense of the gradual building up of ethical attitudes toward earlier unlicensed antisocial activities in which the "sense of guilt" serves as the policeman, i.e., the super ego or ideal ego of Freud.

In short, the song of the psalmist—"Lift up thine eyes to the hills whence cometh thy help"—in the sense of an ethical compulsory substitute for the emergence into consciousness of repressed tabooed wishes—is the primitive, positive level in ethical structure which has built up civilization and culture, and which brings about these movements in the main. It is with this generalization that this paper finally grapples.

PERSONAL OBSERVATIONS

In the past year I have had the opportunity of seeing four examples of oculogyric crises in cases of chronic encephalitis. Two patients were seen but once or twice in consultation; a third was seen without much opportunity for close study from the point of view of oculogyric crises; a fourth showed the development of oculogyric crises in a respiratory syndrome following a chronic encephalitis which has already been reported in monographic form, and hence offers exceptional opportunity for the study of the main issues of this thesis.

REPORT OF CASES

CASE 1.—A. B., now 28 years of age, single, in whose family history there had occurred a psychoneurosis in the father and a psychosis in a brother, had shown pronounced oral erotic fixations; finger sucking was maintained until at least 26 years of age. There was a history of much "necking" with a hoped-to-be fiancée, with some premature coitus activities.

Late in 1924 or early in 1925, a febrile delirium with hallucinatory images of vermin crawling on the walls and over everything, followed by diplopia and sleep reversal formula, indicated the acute encephalitic attack from which a partial recovery was evident. Six months later, there was a gradual onset of muscular rigidity and a continuous tachypnea which continued up to the time of observation. In 1927, there occurred attacks of trance-like states with fixation of the eyes, and lateral, usually to the right, crises. There was no pain, but much anxiety, apparently due as much to the respiratory difficulty as to the eye spasms.

In the short time at my disposal it appeared that the oculogyric crises increased the sense of guilt, which was a constant accompaniment of the respiratory spasms. No adequate outline of this sense of guilt is here permissible, but at the manifest level it was concentrated on the erotic activities carried on with the love object. A brief questioning as to dream material, however, as a part of a routine examination at the time of the consultation, clearly indicated that erotic activities between brother and sister had been present in the childrens' nursery. Thus the sense of guilt had a much more rational foundation in the family incest situation than in the later erotic relationships of courtship.

Reasons of discretion prevent further elucidation of this case history. The case had many analogous aspects with the case of Y, reported in my monograph on respiratory encephalitis.

CASE 2.—This case I hope some day to discuss more in detail under the caption of monoplegic (tremor) forms of encephalitis (Römer,[22] de Lisi[23] and others).

Mrs. J. B. T., 29 years of age at the time of examination, of Russian Jewish origin, one of eight children, reared in the south, had always been well, and no particular hereditary disadvantages were shown by the history. In 1920, she had the "flu." She saw double, had a temperature and was delirious. She made an apparent recovery. In 1923, a "nigger" broke into their chicken coop. This seemed to date the onset of the parkinsonism which consisted chiefly of a mild generalized rigidity, face masked and a bit glairy (seborrheic) and a definite tremor almost exclusively limited to the entire right arm. This tremor, gradual in its inception, advanced until it became unbearable. (When the patient was seen again in November, 1928, the tremor had become more general.)

At times, irregularly and not clearly recalled by the patient, she would have spells of great despondency. Her entire right side would become fixed, the right arm would shake more and more and the eyes would simply "bore through things" so intense was her gaze, directly forward—and occasionally toward the right; of late the eyes would "force themselves" in spite of her, as if she did not want to look at something. She was distinctly suicidal, especially during these "trance-like" states, but the despondency hung like a general pall over all her activities.

My time of observation was short, consisting only of two visits. She presented one dream only. "She had lost her diamond out of her ring." Analysis was not possible. Detailed presentation of the neurologic observations is unnecessary at this time.

CASE 3.—V. L., 15 years of age at the time of examination, the older of two girls, was referred to me by a colleague. In November, 1924, when 12 years of age, she had had a febrile attack, with headache and some eye trouble (double vision) and lethargy, lasting in all about eight weeks. Shortly following this, the patient became unmanageable. She had tantrums, was bold, was obscene in her language, would kick her mother's shins, and all of the well known behavior anomalies were manifest. She was taken to many clinics, hospitals and physicians, but the situation went through a classic evolution in which the tantrums were paramount. She drove her father to drink. She had a period of respiratory tachypneic attacks, each attack being of short duration. These began in April, 1926, and were intermingled with her "rule of the household." She demanded to go to bed with her mother, would talk all night, alternated between affection and anger and "raised hell" in general. Up to the time of the encephalitis, her mother reported she had been a perfect "angel."

When first seen in the office she seemed a nice girl, just emerging into adolescence (she had menstruated at the age of 11). She was in the gawky period. She announced that she did not like "doctors." She had already seen at least a half dozen. One of them had rather brusquely asked her about masturbation, which was then a conscious conflict, and she dreaded any further intrusion on her personality. She was proper in her deportment except that at times she would suddenly and violently dispute a statement of the mother in such language as, "You're a liar"—"You know G. d. well that is not so," and, strangely enough—from my viewpoint she was right. It was the mother whose saccharine rationalizations were unsound. She then went to three different sanatoriums and grew progressively worse.

22. Römer: Ueber eine eigenartige monosymtomatischen Form der Encephalitis epidemica, Deutsche Ztschr. f. Nervenh. **86**:274, 1925.

23. De Lisi, L.: Monotremori di natura encefalitica, Attr. d. VI. Congress d. Soc. Ital. d. Neurologia, Napoli, 1923.

The status of the condition when I saw the patient at her home in March, 1928, was as follows: For the most of the day and night she was up and around. Her life was chiefly a series of episodes in which she went through a fairly regular cycle. She got up from bed, tiptoed stiffly in a large circle, her eyes and head in a fixed oculocephalogyric position to the left, trance-like; she made a menagery series of movements around the room, saying, "don't touch me, don't touch me, don't touch me." She made a semigrunting "brüllen" noise as she went through this maneuver (Schuster, and Benedek) and after five, ten or fifteen minutes, she sought her couch exhausted. She lay here ten, fifteen, twenty or more minutes, sometimes slept an hour or so, and then got up and went through the same series of circus movements. These paroxysmal crises were repeated from ten to twenty times a day.

All kinds of therapeutic attempts have been as yet unavailing, and naturally the family were driven to distraction.

NOTE.—At the time of proof corrections, February, 1929, this patient, while under Dr. L. P. Clark's care at Stanford, has made a complete recovery from her behavior anomalies. She never was parkinsonian. A report of this case is given in the Neurological Society Proceedings, February, 1929.

CASE 4.—J. F. is a patient whose case has been reported in full in my monograph on postencephalitic respiratory disorders [24] where the early history was given in great detail. The account of the analysis of the partial meaning of the respiratory symptomatology is there discussed at length, with what have been assumed to be beneficial results. The patient has had no further respiratory attacks up to 1929. Evidently, however, the entire story is yet to be told.

As Wimmer insisted on the chronic nature of this disturbance, so here a new invasion seemed to have taken place. In the ordinary medical parlance, he had a mild attack of influenza. (At least this is what, as Groddeck puts it in his "Das Buch vom Es," the wiseacres tell us.) Following this, a new phase appeared. He had been well since my last report of his illness. Although he rarely got up before from 10 to 11 a. m., nevertheless, he would get to the store (his father's business) and work until 3 or 4 p. m., then go home, take a nap and be ready either to work in the store in the evenings or to enter into any social situation that arose. A progressive "growing up" had been observable. He seemed to enjoy his work as a junior salesman and had taken on more and more responsibility until this new "febrile attack" seemed to "knock him down" as he expressed it. This had occurred on June 18, 1927. It followed an amatory adventure involving fellatio with emission and then inability to reach an orgasm after fifteen minutes of coitus in which the lady complimented him on his staying powers, but from which he had emerged shaking like a leaf the next day.

He telephoned, or rather his brother did for him, in great alarm. The patient had had "an oculogyric crisis" which had come on suddenly, was "Jesusly painful" and lasted from 4 or 5 p. m. until 2 or 3 a. m., when he finally fell asleep. This was on June 19, 1927. Then, two or three months later, he had a couple of minor attacks. I had not seen him for about three months when he came to the office and told me of these attacks with considerable anxiety and much increase in rigidity. He said he felt nervous, as he had not seen me for so long a time. I also obtained the real details of his so-called attack of "influenza." I received a letter from his brother at this time, Oct. 25, 1927, which reads as follows:

"These periods concerning which I talked with you over the phone today are marked by a severe flexing or turning of the eyeball, always toward the right. They turn upward and sideways.

24. Jelliffe: Postencephalitic Respiratory Disorders, Nervous and Mental Disease, Monograph Series 46, 1927.

"I first noticed this when I talked with you about it early in the summer. It first seemed to develop when he was extremely tired and exhausted and I always connected it with exhaustion. It seems lately to happen about at weekly intervals and he develops it generally on two successive days.

"Sometimes it comes at night and when it does it has lasted as long as two or three hours. During the period this lasts, he cannot of course sleep. When he does fall asleep it is the sleep of exhaustion.

"This eye trouble seems to exhaust him very much. When this seizure is going on, he seems to be in the same state he used to be during his trance periods.

"It seems almost impossible for him to answer questions, which he sometimes does, however, only after the greatest struggle or difficulty. He slows up in all action and motion during this attack.

"He is extremely worried by this symptom, minding it much more than his old time attacks of rigidity, due I imagine to the fact that he was so sick then that he didn't know what it was all about.

"Now this new thing upsets him terribly. Remember that he has had no attacks of any kind to bother him for a long time. He says very little while these attacks last and what little he says is an interjected remark, thrown out during a momentary cessation of the flexing of his eyes, such as today: 'It's all up in the head with me'; 'I keep repeating things when I'm like this'; 'I guess I just deserve this. Everybody gets what they deserve.'

"Today he said to me, 'I wonder if all my trouble comes from masturbation?' I assured him it did not. As a matter of fact I do not think he masturbates nearly as much as formerly.

"During this period, then, he seems terribly worried. However, when it stops and he gets a night's sleep, he does not seem worried next day.

"In other words, he seems to recover from this depression rapidly. Sometimes, he gets this flexing tendency on the way to the theater, but it stops when his interest is taken up by the play. He never has had it during a performance, indicating that when his mind is busy functioning this trouble does not come. Last night, this came on him after an active evening in the store. 'What started your eyes tonight, Jack?' I asked him. 'I keep thinking about it and worrying and they go south,' he replied.

"In the main, his condition seems fairly well. Aside from nights upset by this trouble, he sleeps well; his appetite is normal and good and I believe he has gained a little weight. When we came back from our three week trip to Cuba, he seemed in excellent shape.

"He is not any more active than he used to be and still requires an afternoon nap. But he seems so much more mature than he used to be, so much less a child and a baby, so much more a man. He has unquestionably developed a lot from the old days.

"He has very little of those periods of 'trance' we used to note. Now they happen only as a rule during this eye upset.

"I have tried to assure him that this is only a temporary thing that will pass away, just as lots of worse things did. He needs to be reassured of this, I imagine, and encouraged, by you.

"I thought at once, just as you said over the phone today, that the same thing was taking place in his eyes as used to happen in his hands.

"He certainly is a game little kid and it almost breaks my heart to see him have this new trouble. I hope you will find a way to handle it.

"I am hastily typing this to you so that you will have this information when we come up, on Friday, at 2 p. m. It would worry Jack if he knew that I thought

this thing was serious enough to make it the subject of such a long memo. So please don't tell him I wrote you.

"I think the whole thing needs to be minimized in his mind, because otherwise he will worry dreadfully.

"I have tried to be as complete as possible in this. However, this eye trouble is only part of the picture. Aside from it, he is O. K. and a thoroughly acceptable human being. I say this so that you won't get an overdrawn picture of things from this note.

"I gave him luminal, two or three times. I told him it was a bromide, because you will recall Burr used to prescribe luminal and if J. knew I was giving him that, he'd imagine he was in bad shape.

"This is certainly a disjointed letter. But I thought it best to get it off at once. Regards."

His brother and I finally discussed in his presence the possible desirability of cutting into the hypothetic chronic infectious nature of the process; his alarm was manifest and he went into one of these characteristic emotional trance-like states, with at first central ocular fixation and then upward movements of the eyes. During the attack, the parkinsonism increased, he perspired and began to murmur, "A million ideas are going through my head; rape my sister, rape my mother; kill my brother, kill my father." "Am I going crazy? Doctor, oh, doctor (almost pleadingly), tell me am I going crazy?" "Am I going crazy," as in the frequently heard compulsive neurotic complaint, is the burden of his story. This was the general burden of his distress which reached the extremes of anguish. He went home with his brother, and this attack, chiefly of anxiety, with upward and outward eye movements, persisted about thirty-six hours.

Mindful of Magnus' conceptions of the position, head and eye reflexes I tried the various maneuvers[25] in my patient during his crises, and found that the eye position was modified strictly in accord with the ideas of the physiologic requirements. The patient was functionally, i. e., primitively, decerebrate. Anatomically, he was far from decerebrate. This is a fascinating problem which involves most intricate psychologic correlates.

As may be seen by any one reading the abstracts of the histories here recorded, this is a typical example of what occurs in other patients, with many variations. In some there is little or no anxiety; in others the anxiety approaches the "melancholia" type and may even lead to suicidal effort.

On the occasion of an attack, this patient made a futile dash to throw himself out of the window in order to get away from his "thoughts."

To me, at least, it is important to record that for the past several months I had seen this patient only irregularly. Either economic or other considerations have seemed to interfere. Any one with "imagination" sufficiently sensitized feels how sensitive these professional relations may become without detailed consideration. As a minor, he was dependent on his father; "business" was "rotten," hence economy was in the air. This he felt acutely, and when he saw me after an interval of two or three months, his anxiety had in it a bit of this situation. This is what is often envisaged behind the broad and not altogether comprehended term "emotional." He had had a workable "positive transference" with me, but there were interfering factors; hence, the irruption of the whole emotional conflict

25. Gordon Holmes (Holmes, G.: Proc. Roy. Soc. Med. **21**:994, 1928) speaks of these maneuvers which are also discussed with illustrations in Stern's (footnote 8) excellent paper. Stern, F.: Die epidemische Encephalitis, ed. 2, Berlin, Julius Springer, 1928.

when the ticklish and important subject of materialistic, mechanistic and intravenous therapy was broached.

At all events, the intrapsychic situation in this patient, now studied at times for two or three years, offers certain suggestions of what seems to be of great significance. Full discussion of the respiratory situation has been presented, although from reviews received of my monograph devoted to this subject it is apparent that the presentation of the situation has not been as clearly perceived as might be wished. In fact, few have apprehended what full acquiescence to the Hughlings Jackson program really implies.

In this particular thesis, it is hoped that its statement—i. e., Hughlings Jackson's conception—will be more explicit, since the "anxiety"-"sense of guilt" situation offers some advantages, which the "respiratory level outlet" could not make intelligible, except to certain few individual minds, lacking fixed prejudices and free to operate with new concepts.

The factors dealing with the psychoanalytic observations in this and other cases will be taken up in the chapter on psychopathology of the positive level symptoms.

PHENOMENOLOGY

The oculogyric crisis, as such, rarely, if ever, occurs alone. Even though Wimmer has reported such it is not improbable that accompaniments in the psychologic sphere were not, for the time being, included in the picture by him.

Hence, in the consideration of the phenomenology, or clinical picture, attention will be here directed toward other features bound up in the attack, viewing it as an attack. The consideration here given then has certain analogous, if not homologous, relationships to what have been so widely described as hysterical attacks, at one end of a sliding scale, to epileptic attacks at the other end.

In a more or less fully developed oculogyric attack, in the encephalitis frame, one may consider the eye movements, the thought disturbance, the emotional state and the nature of consciousness or vigilance.

1. In a classically developed attack the eyes move to an extreme position toward or away from some actual or introjected (i.e., imagined or "symbolic") object. In the period in which the patient is well the eyes do not show any evidence of paralyses, and even during the attack itself the eye movements may be able to move if focused on some moving examining object. In the few cases reported on (Stern, Holmes and myself), passive movements of the head cause the classic alteration of the eyeball position seen in the Magnus reflex testing maneuvers.

2. The thought movement is slowed. Bradyphrenia was an earlier designation (Cruchet, Hesnard). Stickiness, or slowness of thought are other appellations.

3. The emotional state is one of anxious compulsion.

4. Involvement of consciousness (vigilance) varies from slight to marked degrees of involvement.

The phenomena will be discussed under these general headings.

EYE MOVEMENTS

As already indicated, there is really little new in the phenomena of oculogyric crises in encephalitis. There is, on the other hand, an enormous extension of knowledge of an innumerable series of variants. Although Albrecht, of Hildesheim, did give a striking picture, and possibly others before him, this, and other facts, while of interest, are of value to the historian rather than to the clinician. In the opening paragraphs of this thesis, it is indicated that an assiduous student might carry the story back to Hippocrates.[26]

The most definite records of these ocular positions may be found in the paintings of artists of the middle ages. Here, however, there is little intimation of what is ordinarily thought of as a disease process. Ecstasy, devotion, raptus, sometimes defence, these are so frequent as to be deemed physiologic. In fact, in contact with "religious" phenomena, it may be said that most persons lose their usual bearings and fail to include the phenomena observed in the ordinary frames of reference. These so-called supernatural phenomena—possession, etc.—"come from without"; they are not so often thought of as really arising from within, i.e., as products of the It, i.e., the "Unconscious."

Since "science," per se, is only one of the many "fictions" in the frame of relativity, may it not be of service to enter for the moment into the "poetic" or "mythologic" frame and see what this aperçu may offer?

Many another has fragmentarily stated what Freud has succinctly recorded that "affective states are incorporated into the soul life as precipitates of archaic traumatic experience and are awakened in like situations in memory symbols."[27] This is but the von Baer-Haeckel generalization that ontogeny recapitulates phylogeny, not only as to structure, but as to its predecessor function. Ethics is but one of the higher or later functional precipitates of experience.

"It has seemed to me," wrote Henri Meige,[28] "that the veil of the past might attenuate the aridity of a psychiatric theme; that in history, yes even in legend itself, there is much material for more than one reflexion for the psychiatrist and the neurologist, as for all curious spirits, to compare yesterday with today." In saying which he turns the attention of his audience to the Delphian Oracle and its instrument, the Python, that legendary serpent which inhabited the ancient village of Pytho, was killed by Achilles of the vulnerable heel, brother of

26. Jonathan Wright has done this for Coelius Aurelianus, New York M. J., 1921.

27. Freud, S.: Inhibition, Symptom and Anxiety, Psychoanalytic Institute, Stamford, Conn., 1927.

28. Meige, Henri: La Pythie de Delphes, Congrès de méd., Aliénistes et Neurol. de France, Luxembourg, Aug. 6, 1921; also quoted by Bing and Schwartz but not from the same angle.

Diana, out of Latona by Jupiter, and rotted there (puthesthai). On this the ancient city Delphi arose. It became the religious and moral center of the ancient world—"la terre ombilical."

The legends of its origin are many. Overdetermined is the psychoanalytic conception which finds the same series of affective precipitates in all myths, legends and dreams.[29]

As Lempriére puts it:

> A number of goats that were feeding on Mount Parnassus came near a place which had a deep and long perforation. The steam which issued from the hole seemed to inspire the goats and they played and frisked about in such an uncommon manner that the goat herd, Coretas by name, was tempted to lean on the hole, and see what mysteries the place contained. He was immediately seized with a fit of enthusiasm and his expressions were wild and extravagant and passed for prophecies. The same circumstance was soon known about the country, and many experienced the same enthusiastic inspiration. The place was revered, a temple built, and soon the "oracles" went forth, later through the priestess Pythia. The motto over the doorway was "Know Thyself."

There is little need of further elaboration since Freud in his "Mass Psychology and the Ego" has shown the inner libido dynamics of all such "transference" phenomena, countless examples of which have appeared in history. Even at the present time persons electioneering for presidential candidates utilize similar methods of propaganda; books attain phenomenal sales, and other sales programs contain "legendary" attributes that influence the masses. A skilful "manager" can "put over" almost anything on the public today.[30] The primitive affective precipitates of biologic experience are present today just as they were in the days when the oracle of Delphi arose, and "Know Thyself" is just as good a slogan at the present time as in those legendary times.[31] At no time and in no place have there been or are there not to be found prophets as well as devotees who would tell or who would know of the future.

In earlier days there were "epidemic" manifestations of such mass psychologic reactions; a few survived permanently, or arose episodically. For the most part, the attenuated indicators of the same identical situations are to be found in the astrologic horoscope casters, the palm reading, card reading, fortune tellers, etc.; yes, even the "tipsters" of the stock exchange are not entirely out of a job.

"Prophetomania," as Meige aptly terms it, still exists, and nowhere so vibrant as in that type of behavioristic reaction broadly termed religious.

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29. Rank, Otto: The Myth of the Birth of the Hero, Nervous and Mental Disease, Monograph Series 18, 1913. Abraham K.: Dreams and Myths, Nervous and Mental Diseases, Monograph Series 15, 1912.

30. Putting the Psyche to Work, American Mercury, June, 1928.

31. For instance, the Elmer Gantrys in the religious field.

Throughout this entire series of manifestations, similar affective precipitates are discernible. In ancient days, the terms used were less disguised. Bipolar situations—ambivalence—stands out. The ancients spoke of the mysteries, the "possessions" as the work of the "nymphs." Homer called them the daughters of Zeus. Theocritus, called them "demons." Thus the "possessed" of ancient Greece did not differ in any essentials from the possessed of the Middle Ages. Only the Greeks named such "nympholepsies." Demoniac possession in the Middle Ages received more rationalized appellations. The witches of New England met with even more puritanically repressed disfavor, from which, it may be noted, possibly the twentieth century has not yet been freed.

The allegoric robes, however, cover the same affective skeletons of human experiences. Dionysius and Bacchus of the ancients, mania of the psychiatrists, mesencephalic decerebrate reflex activities of physiologists are not entirely unrelated situations, even if here rather turgidly compressed and topsy turvily thrown together. To any one minded to trace out the blue print more carefully, Meige's charming address is recommended. Should one wish a larger map—Fraser's "Golden Bough" is offered.

But, before this larger research is entered, even if in imagination only, a detail of the picture is worth dwelling on. Meige's account is still in mind—as he offers the picture of the third century—as told by Lucien.

At the height of the Delphian ceremony, the possessed "Virgin" appears. "Regardez la"—look at her—"she hesitates they say." "She is afraid." She seems to advance against her will (*ἀκούσια καὶ ἀπρόδρομος*).

"In truth is she not in a state of somnambulism?" The Delphian priests are such capable magnetizers.

However, like an automaton, the Pythian goes toward the tripod; seats herself there, her limbs wide apart—and waits.

She shivers, it is the god that approaches her: Deus, ecce deus. His breath, it touches her; it envelops her; penetrates her through the most secret parts. He finally possesses her, for the "python" is the succubus of Apollo.

Then there unfolds the crisis, which, in the eyes of the ancients, was the certain index of the divine mania and in which (Meige stated a little too prosaically and statically narrow in the interpretation) one can recognize the attack of grand hysteria. A long cry—the initial cry —strange, impressing, followed by sighs, tears and murmurs. Then oppressed, breathing heavily, the priestess gives way to loud cries. Her face, formerly so red, becomes pale, it passes from the redness of fire

to the lividity of fear. She rolls her eyes furiously, convulsively toward the skies; froth comes from her mouth.

Then follows the convulsive stage.

It is unnecessary to go on with this classic description—so well outlined by Richet and at the Charcot school. This is the "hysteria" of that day, and many are satisfied with giving a psychobiologic process, of many millions of years in the making, a semicontemptuous appellation "hysteria" as if by this term anything had been contributed to its understanding!

Thus is exemplified anew that "first distemper of learning" which Bacon spoke of as "naming" things and thus hiding behind the name the essential significance of the process; or, as F. C. S. Schiller phrases it, "counting oneself happy with the acquired meaning of a 'word,' instead of the difficult investigation of the behavior of a 'thing'."

Thus can one not spew, for the time at least, all such words as suggestion, hysteria, hysteriform, pithiatism on the one hand, and, on the other hand, such hypothetic word pictures as cortical representation of conjugate eye movements (Bechterew and others), supranuclear irritation of the posterior longitudinal fasciculus (Borremans [32] and others), thalamic over-response, involvement of the rubrospinal tract, striatal control, neostriatal injury, cerebellar involvement, or vestibular involvement? Can one not try to find out just what is going on in these cases of oculogyric crises that on the one hand forces (compels) certain bits of Pythian goddess behavior into the foreground, and, on the other hand, as is readily agreed, may be bound up in some manner with various types of defect in the human machine?

Here one turns again to evolutionary concepts in searching for an understanding of behavior activities as well as structural correlates and to the formulations of Hughlings Jackson and—be it noted—to necessary extensions of these formulations (von Monakow), since Hughlings Jackson dealt little with the ethical-moral precipitates of human behavior, which von Monakow [33] has studied in great detail.

OCULOGYRIC PHENOMENA IN ENCEPHALITIS

Coming to a summary of the actual situations as deducible from the rich literature and from personal observation, attention may be called to the thesis that the ocular movements per se are not a feature essential only to the postencephalitic situation.

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32. Borremans: Crise de contractures spasmodiques verticales du regard au course du syndrome parkinsonienne postencéphalitique, Rev. neurol. **1**:501, 1925.

33. Von Monakow, C.: The Emotions, Morality and the Brains: Tr. by Gertrude Barnes and Smith Ely Jelliffe, Nervous and Mental Disease, Monograph Series 35, New York and Washington, 1925. Von Monakow, C., and Mourgue, A.: Introduction biologique à l'étude de la neurologie et de la psychopathologie, Alcan, 1928.

This is evident as soon as the whole series of instances in which such movements occur is surveyed. From time immemorial these movements have been known to occur in the epileptic attack.[34] They have been seen in many persons in psychotic states, notably in catatonic schizophrenic and manic schizoid states; also in the manic phase of the manic-depressive psychosis. Pearson[35] has written an excellent summary of their occurrence in neurosyphilis. They have been seen in cases of brain tumor and, as already indicated, in patients with arteriosclerotic paralysis agitans (Vorkastner). As a pure expression in hysterical attacks, the early literature is full of them, even if it may be granted that some of the early records are not all true cases of conversion hysteria. Furthermore, as true compulsive neuroses—"tics"—there is equally bona fide evidence of their occurrence in pure culture. It is here assumed that Meige and Feindel, and Cruchet[36] were correct in their attitude toward what they differentiated as "organic" and as "functional" tics, broadly interpreted. Wilder and Silbermann[37] have discussed some of the aspects of this phase of the problem, as has also Kinnier Wilson (1927) in his valuable and lucid contribution on "Tics and Allied Conditions" (Wilson's "Collected Studies, Arnold, 1928).

It is not the place in this section on phenomenology to discuss the numerous conceptions and interpretations of these oculogyric movements. After pointing out the numerous types observable, I shall focus attention on the postencephalitic group as clinical phenomena. Just where they belong in the complete picture puzzle, and particularly "why," will be taken up later.

In a broad metaphorical sense, the postencephalitic cases are separated out from others, much as the pulp-wood lumberman goes through a forest section and cuts out only the "poplars" for the use of the paper manufacturer. Other trees may be just as useful in the making of paper, but this lumberman's ax is interested only in "poplar," and this is the kind of tree that he cuts down, peels, piles and makes ready to be hauled to the mill. Because of this "selection" no one should assume his ignorance of the values of other trees, even for paper production. Least of all should he be considered "prejudiced" in favor of "poplar."

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34. Staehelin's case (1921), extensively quoted by writers on the oculogyric crises, was one of convulsions in a hemorrhagic encephalitis and pneumonia with eye movements, lasting one and one-half minutes before coma and death.

35. Pearson: Spasmodic Association Movements of the Eyes: Can They Be Produced by Syphilis? Arch. Neurol. & Psychiat. **18**:414 (Sept.) 1927.

36. Cruchet: L'anoblepsie et les spasmes oculaires toniques post-encéphalitiques, Rev. d'oto-neuro-ocul. **5**:280, 1927; Séquelle d'encéphalo-myélite épidémique-crises convulsives des globes oculaires, J. de méd. de Bordeaux **103**:925, 1926.

37. Wilder and Silbermann: Beiträge zur Tic. Probleme, Berlin, S. Karger, 1927, p. 70.

Thus one comes to grips with the oculogyric crises as showing late in encephalitis. Practically all observers record the fact that these crises have been observed only in those postencephalitic crises which have developed, more or less completely, the so-called parkinsonian syndrome. For myself, I am prepared, in the face of this evidence, to concur provisionally with this generalization, although I am not entirely convinced that it is a necessary concomitant. If this hypothesis be admitted in its entirety, then one must assume that the parkinsonian syndrome, as such, is a necessary bit of the entire mechanism.

Wimmer phrases it as follows:

> Thus, my cases, like those reported in the literature, seem to indicate a very close connection between the oculogyric crises and encephalitic parkinsonism. This intimate rapport might not be expected beforehand, seeing that in parkinsonism we have, generally, a continuous (alterations—S. E. J.) condition of hypertonicity and rigidity with a more or less marked akinesia, the syndrome for the greater part

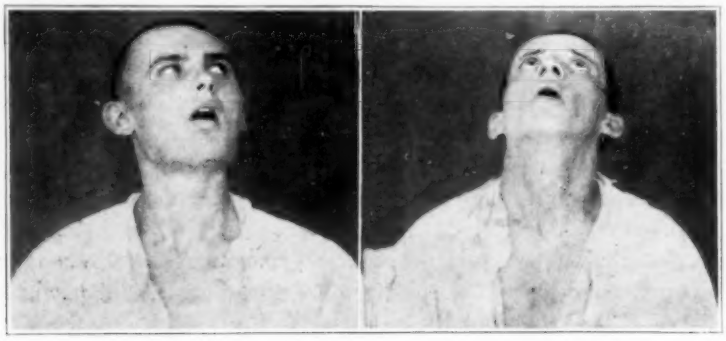

Fig. 2.—Oculogyric crisis in one of Marinesco's patients.

> developing slowly and with but few oscillations during its further course. The paroxysmal fits of oculogyric crises should seem, then, to agree better with another encephalitic syndrome, viz., that which is by preference characterized by hyperkinesia, the athetotic and torsion spasms syndromes, for instance.
>
> These tonic fits (Wimmer quotes the cases of Lemos,[38] Sterling,[20] Marinesco,[39] Zingerle,[9] Gurewitsch and many others), especially marked cases, bear a rather strong resemblance to the tonic phase of the genuine epileptic convulsion attacks. Hence Sterling's "extrapyramidal epilepsy," Zingerle's "Cramp type of the brain stem."

If all this be true—and I reserve judgment whether it is so—any interpretation of the oculogyric crisis as a movement must include the larger picture of the hyperkinetic-dyskinetic syndrome now envisaged

38. Lemos: Rev. neurol. **2**:425, 1924.

39. Marinesco, Radovici and Draganesco: Accesé de spasm al deviatei conguge (acapuluisi oculor) Spitalul. no. 6, 228, 1924; Acces paroxystique hypertonique de déviation conjugeé de la tête et des yeux au cours de parkinsonisme post-encéphalitique, Rev. neurol. **1**:148, 1925.

as the parkinsonian syndrome. When one faces this generalization, even though of the various authors Wimmer most particularly states it, I reserve judgment in view of the larger survey of the vast number of other studies of the possibilities of the dissection of these syndromes. One single reflection bolsters up this discriminative attitude. It relates itself to the colossal complexities of the phyletic synthesis of movement in the human aggregate.

Complex as this aggregate may be, and numerous as have been and are the efforts to reduce it to simpler radicals, my own feeble efforts to comprehend the situation may be viewed, and rightly, as purely tentative and suggestive rather than in any degree final. Certain critics have deemed it proper to overlook this conservatism as evidenced in other papers, notably in my "Respiratory Syndrome" and the "Schizophrenia-Encephalitis" papers, and have spoken of a "dogmatism" which is far from justified; hence, the emphasis here again. My suggestions

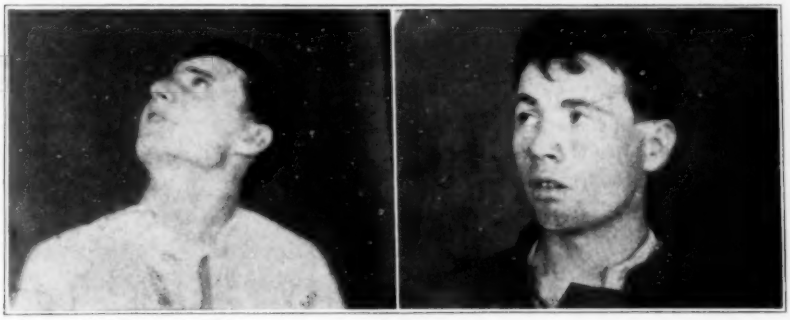

Fig. 3.—Oculogyric crisis in another of Marinesco's patients.

may have seemed radical, but they were put forth as scientific hypotheses to be checked up by others who were willing to work in the same frame of reference. Thus, should it here be attempted to be shown that even behind the parkinsonian attitude, the other hyperkinetic situations apart, one may detect psychologic regressive situations with ethical implications, I am satisfied that the interpretation set forth offers some food for reflection. It cannot be dismissed as "metaphysical," or "mystic," or other such nonsense.

These oculogyric crises, then, are not necessarily found only in parkinsonian cases, but as the evidence is preponderantly in favor of this association, as may be read in the digest of the cases, the specific generalizations here discussed concerning the one situation (the crises) may possibly be interpreted as a contributing factor in the other (the attitude). This phase of the discussion belongs later.

The records collected and personal observations also seem to show that the vast majority of the oculogyric crises appear comparatively late in the development of the entire parkinsonian situation. Only one

reported case, and this was not as completely studied as might be wished, presents the oculomotor phenomena as developing pari passu with the parkinsonism. This is the case of Vivaldo [16] which, because of its psychotic admixtures, prevents any deductions of value in this present discussion. At the other extreme, Wimmer's case that developed seven years after the initial encephalitis is to be considered. In the 200 cases here abstracted, the onset of the ocular movements took place somewhere between these limits. To some industrious statistician is left the preparation of a table or graph to show this incidence of onset. For myself, I believe it as yet irrelevant without more detailed anamneses. Hence, this is a question for the future to decide, if it should turn out to be of possible value.

CLASSIFICATION, PERIODICITY AND SEVERITY OF THE EYE SPASMS

Classification.—Roger and Reboul-Lachaux,[40] in their Geneva report (1926), and later (1927),[41] emphasize a differentiation between tonic and clonic types of spasm and speak of spasms of convergence.

Thus, they offer a classification which is of interest, even though it is here held to be of little value, since, for instance, a single patient in one or in different attacks will present one or all of the forms outlined. I have observed this, and in some of the more carefully prepared reports the same situation is evident. While it may be of much significance as to the prevailing kind of movement in the crisis, certainly no suggestion as to reasons for the specific direction of the movements is to be found in any of the papers here reviewed.

Roger and Reboul-Lachaux's classification is as follows: 1. Tonic Spasms: (*a*) Simple. One direction, usually vertically most frequent, or down, right or left. (*b*) Variable or Alternating. (*c*) Bipolar—successively opposite directions, vertical or horizontal.

2. Spasms of Convergence: rare and not observed by the authors.

In the reports, such spasms are frequently recorded. They were usually present in my own cases. They are easily overlooked since they are often transitory. The outstanding fact that some loss of convergence power is almost universal in parkinsonism brings up the question of the phylogenesis of the function of convergence in binocular vision (Brouwer's able discussion). As this late arriving synthesis is less highly organized and hence more capable of impairment, and since

40. Roger and Reboul-Lachaux: Essai de classification des spasmes oculaires au cours de l'encéphalite épidémique a l'occasion de cinq nouveaux cas, Congrés des méd. Aliénist. et Neurol. de France **30**:321, 1926.

41. Roger and Reboul-Lachaux: Les spasmes des inferogyres dans l'encéphalite épidemique, Rev. neurol. **2**:665, 1925; ibid., Rev. d'oto-neurol-ocul. **5**:120, 1927; Les spasmes oculaires de fonction dans l'encéphalite épidémique, Ann. de méd. **22**:19, 1927.

hypolabyrinthine sensitivity is also a frequent postencephalitic concomitant, a double loss from the somatic side cannot fail to have an important repercussion in the sense of stability or equilibrium, which as a physical stabilizer in time and space plays an enormous rôle in the affective sphere (Bing and Schwartz [18]).

3. Clonic Spasms: convulsive in type.

My reading of the G. Lévy cases does not coincide with their view. Further, these clonic states are frequent in the beginning of most of the crises observed by me and can be detected in the records abstracted in a previous chapter of this thesis. (*J. Nerv. & Ment. Dis.*, Jan., 1929.)

As Roger and Reboul-Lachaux observe, these movements are irregular. My own observation and readings show them to be extremely so, and yet at the same time my interpretation of these movements often shows just why the particular direction chosen as more predominant is so chosen—i.e., "chosen" here being interpreted not as wittingly so, but as the result of unconscious sets of factors.

As most authors have recorded and most of the photographs published show, the prevailing direction is upward—to the right. This is possibly not without some significance from the interpretation to be dwelt on in later phases of this inquiry.

The Crisis.—In its complete or fully developed form as already outlined, this is a complex compulsive phenomenon involving at least the four factors mentioned and nearly always associated with other highly intricate reflexogenic protopraxic (Dodge) movements, the extreme expressions of which have been made the subject of many studies, to quote only those of Foerster, Zingerle, Gamper and Untersteiner as samples.

The onset of the crisis is most frequently correlated with some affective disturbance (emotional stimulus from the outside chiefly), frequently referred to as "suggestion" (Marinesco and Radovici [42]), mental contagion (van Bogaert,[43] and others). Internal factors, such as fatigue and hyperthermia, are recorded. Also provocative stimuli—lights, sounds, smells, commands, hyperpnea and other situations hitting a highly sensitized organism (unconscious sensibility as in any organism engaged in conflict with a devastating attack on synthetic controls)—these are of much significance in understanding why an attack is set

42. Marinesco and Radovici: Mécanisme physiologique des crises hysteriformes de déviation conjugée de la tête et des yeux au cours de parkinsonisme, Rev. neurol. **1**:219, 1926.

43. Van Bogaert: Crises oculogyres latérales puis verticales, Soc. Belg. d. neurol., May 21, 1927; Rev. neurol. **2**:203, 1927; Déclanchement des crises oculogyres par l'epreuve de l'hyperpnea, Tr. Soc. Belge d. Neurol., May 21, 1927; ibid., Rev. neurol. **2**:207, 1927. Helsmoortel and van Bogaert: Recherches zur l'état des fonctions vestibulaires dans les crises oculogyres de l'encéphalite, J. de neurol. et psychiat. **27**:574, 1927.

off. It is necessary to be oriented to the affectivity in the narcissistic neuroses, schizophrenia, the manic-depressive psychoses or the graver psychoneurotic, hysterical or compulsive states to evaluate properly this affective sensitivity. To be satisfied with such terms as "suggestion," "mental contagion," "pithiatism," "psychopathic," and similar words is hardly more advanced in insight than to accept what the average internist avoids looking into when he speaks of "nervousness."

The usual beginning of an oculogyric crisis shows this affective situation either by an advancing malaise, a sense of insecurity or even vertigo, as recorded by many; Bing and Schwartz, as will be discussed later, view this vertigo or sense of insecurity solely from a somatogenic standpoint. This is but one part of the real situation, as may be developed further.

It is believed to be unnecessary to summarize those reports which show only upward movements, upward and to the left (Reys,[44]) vertical oscillations (Bertolani[45]), etc. The fact is that these movements change a great deal and need not be cataloged here. Neither is it of much significance to enter into a discussion of the cephalogyric accompaniments further than saying that here is a promising field of study by the Magnus de Kleijn maneuvers to learn somewhat of the associated postural reflex activities of the eye and head. (Stern,[46] Holmes,[47] Jelliffe,[48] and others). Roger and Reboul-Lachaux have gathered together a number of these, which as a preliminary and rough survey should be consulted. These include the eyelid movements as well, and are extremely complicated.

Pain during the ocular movements in the eyes themselves or displaced to the other regions of the head, headaches and violent vascular pulsations constitute a special problem as do the vascular congestions more or less commensurate with the duration of the crisis.

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44. Reys: L'encéphalite épidémique, 1922; encéphalite épidémique, Clin. opht., 1923, vol. 12; Spasmes paroxystiques d'élévation des yeux, chez trois parkinsoniens, Soc. Oto neuro oculist, Strasbourg, Dec. 13, 1924; Sur une variété spéciale de troubles des mouvements associés des yeux, Rev. d'oto-neuro-ocul. **3**:65, 1925.

45. Bertolani: Manifestazione coatte accessuali della motilita oculare associate a disturbi psichic nell Encefalite epidemica cronica, Riv. Sper. di freniat. **49**:333, 1925.

46. Stern, F.: Die epidemische Encephalitis, Berlin, Julius Springer, 1922; (footnote 25, second reference).

47. Holmes, G.: Encephalitis: Ocular Complications, Proc. Roy. Soc. Med. **21**:994, 1928.

48. Jelliffe: Nervous and Mental Disturbances of Influenza, New York M. J. **108**:725, 1918; Postencephalitic Respiratory Disorders, Arch. Neurol. & Psychiat. **17**:627 (May) 1927; Somatic Pathology and Psychopathology at the Encephalitis Crossroad: A Fragment, J. Nerv. & Ment. Dis. **61**:561, 1925; The Mental Picture in Schizophrenia and in Epidemic Encephalitis. Their Alliances, Differences, and a Point of View, Am. J. Psychiat. **6**:413, 1927. Jelliffe and White: Diseases of Nervous System, Introduction, ed. I to V, Philadelphia, Lea & Febiger, 1915-1929.

Linked up with the spasms there may be negative symptoms of paresis from somatic involvement of eye nuclear, supranuclear or cortical synapses in the form of strabismus, Magendie-Hertwig phenomena, pupillary inequalities and other conditions. These are not necessary parts of the "spasm crisis" as such, and represent left-overs of the original focal invasions of the encephalitic process.

The occasional accompanying palilalias, grimaces and champing, as well as salivatory, grunting, crying and masticatory and other ticlike movements, need not concern us here.

The labyrinthine symptoms are undoubtedly of great significance. It cannot as yet be said that the available studies are sufficiently coordinated to offer fruitful hypotheses. Fischer,[49] early, and Helsmoortal,[50] van Bogaert [43] and others, later, have studied these. So far the only apparently valid generalization is that these patients show some disturbance of some of the labyrinthine reactions—chiefly in the trend toward a reduced capacity of protopraxic adjustments.

The pupillary symptoms are worthy of special consideration at this place. They are purposely left outside the picture although they, like so many other signs, are pertinent to the discussion. Westphal [51] called attention to them early in encephalitis as pupillary immobilities. They have been related to catatonic pupillary crises, hysterical stupor pupillary states. Bumke's designation, "terror" pupils, is specially germane to the point of view here to be further elucidated, especially as it will be emphasized that "terror," as well as "raptus," must be thought of from the Hughlings Jackson conception of "disintegration of function" to lower levels, Kretschmer's "primitive reaction" notions, and, more particularly, Freud's ideas relative to "regression."

Blinking movements also should demand attention in the consideration of these oculogyric spasms; also the position of the eyes during sleep, as well as the collateral evidence of the eye movements during anesthesia.

Many authors have spoken of the blinking movements in the records that I have abstracted. The relation between blinking (as a defense) and upward rolling is very intimate. In his intriguing paper,

49. Fischer, B.: Ueber vestibuläre Beeinflüssung der Augenmuskelstarre bei der Encephalitis epidemica, Deutsche Ztschr. f. Nervenh. **81**:164, 1924; Zwangsmässige Bewegungen bei der Encephalitis epidemica, Med. Klin. **20**:1469, 1924.

50. Helsmoortal: État des fonctions vestibulaires dans les crises oculogyres postencéphalitiques, Rev. neurol. **1**:671, 1926; ibid., Proc. Belg. neuro-ophthalm. Soc.

51. Westphal: Ztschr. f. d. ges. Neurol. u. Psychiat. **68**:266, 1921; Zur Frage des von mir beschreibenen Pupillenphamomens bei Encephalitis epidemica (Wechselnde Pupillenstarre, spasmus mobilis de Pupillen), Deutsche med. Wchnschr. **51**:2101, 1925.

E. Bramwell [52] has discussed this synchronism, as well as the significance of the sleep position (French doll phenomenon) and the eye position under anesthesia.

Periodicity.—Up to the present time, valid conclusions may not be adduced concerning the periodicity of these attacks. The careful reading of the abstracted material shows several attacks a day, daily attacks, every other day, every third day, every fourth day, weekly, etc. They may occur at 3 o'clock (Reys), or 4 o'clock, at 7, 8 (Roger and Reboul-Lachaux), or at any other set hour. Again all is confusion. In fact, the variability in time argues that careful psychologic analysis is necessary in order to obtain any light on this aspect of the situation (Hesnard, Bériel and Bourrat [53] and myself).

It is not without significance, however, that in most of the cases the attacks have increased in frequency and in severity. Somatically interpreted, this argues for the advance in organic deterioration. Psychiatrically envisaged, the factor of "regression" is equally in need of investigation.

Severity.—A generalization is not valid as to the severity of the attacks. A few patients show a more or less stereotyped form of attack; but, for the majority, the attacks are shorter and longer, simpler or complex, transient or prolonged. A few last minutes only and are followed or interspersed with those lasting one, two, three or more hours. One of the attacks in my fourth case lasted thirty-six hours. In case 2 the attacks continued at intervals of fifteen minutes or so, all day and night, and have continued for several months.

The lack of ability to control the situation in some cases and in some attacks stands in definite contrast to an opposite aspect of capacity to stop an attack. The latter aspect of a conscious control has led certain observers to suggest even "malingering," "naughtiness," "hysteriform" and other conditions. In these aspects one can read the static nomenclature tendency of the observers. The dynamic situation is not emphasized by them. As with many other related compulsive phenomena, efforts at control are often accompanied by intense anguish. Few observers, however, have seemed to grasp this. Van Bogaert and Delbeke [54] have appreciated this and commented on it, likewise Ewald [55] and Stern.[46]

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52. Bramwell, E.: The Upward Movement of the Eyes, Brain **51**:1, 1928.

53. Bériel and Bourrat: Convulsions oculaires dans le cours de l'encéphalite chronique, Bull. Soc. méd. de hôp. de Lyon, Feb. 17, 1925, p. 530; Rev. neurol., 1925, vol. 1.

54. Van Bogaert and Delbeke: Contagion des crises oculogyres chez des parkinsoniens postencéphalitiques, J. de neurol. et psychiat. **26**:269, 1926.

55. Ewald: Schauanfälle als postenzephalitische Störung, Monatschr. f. Psychiat. u. Neurol. **57**:222, 1925.

In a great many of the reported cases, the patients can follow a finger with the eyes during a crisis while under command (diversion) from the outside. The eyes go back to their original position, however, and even during the maneuver there is often much increase in anxiety. All this is a commonplace in the literature of the "compulsion neurosis" or in an effort to overcome "habit forms" in general, as shown by the vast literature surrounding any breaking into "ritual": orthodox Jewry and pork; Catholicism and Friday fasting; the behavior with reference to number thirteen and other kinds of deep-lying "superstitious" observances. As this study will enter later more deeply into this "ritual" situation, this brief comment is sufficient at this time.

Likewise one finds that some observers have cut short an attack by "hypodermics of water" after injections of scopolamine had helped (Marinesco and Radovici) or other claptrap, thus arguing as to the exclusively pithiatic nature of the phenomena. This aspect of the problem is likewise referred for later consideration. One can state here only the belief that this is a superficial way of looking at a highly complex situation. It tends to belong to the "dormez-dormez" Bernheim hysteria era of thinking or the "ce passe, ce passe" of later vintage of the pharmacist "Coué." At the same time these facts tend to show that there are a great many variations in the dynamic situation in different patients who come under observation. Some are undoubtedly in a more serious condition than others, both as to somatic involvement of important subcortical and cortical mechanisms and as to psychoneurotic susceptibility —"Krankheitsbereitschaft Begriff." As all this is bound up in the "Biologie der Person" (Kraus-Lewy), it cannot be dismissed with a shrug of the shoulders. "Constitutional" factors (Martius, Pende, Bauer, and Draper), including the more subtle and less clear situations hiding behind "heredity," must also be brought into the picture.

THOUGHT PROCESSES

It is unfortunate from the phenomenologic aspect that in the reports of the oculogyric cases here recorded the information is so scanty relative to the "thought processes," i.e., the bradyphrenia—or stickiness of thought. This is an extremely intricate problem, or rather, set of problems.

In the abstract presented as an introduction to this chapter, the broad generalization is offered that "thinking" may be said to be but an inner mechanism of motion. This is a notion dear to the "behaviorist's" naive view of thinking. As even a partial discussion of the origin of thinking from motor patterns, via, the erect posture, freedom of hand motility, and later facial, trigeminal and hypoglossal activities, chiefly taking over by speech by symbolic sound meanings, would lead into an involved evolutionary labyrinth I do not wish to attempt any essay in this direction.

It seems valid to assume, however, that the "thought blocking" is an essential part of the process and that it is a correlated part of the akinetic-dyskinetic situation (bradykinesia, bradyphemia, bradyphrenia of numerous authors, as Verger and Cruchet, Hernan, Boerstroem, Stern, and others).

May it not be said that without a somatic substratum (negative symptom side of Hughlings Jackson) this could not take place? In short, one may deduce that those patients who show it more evidently have had greater impairment of the somatic structures, and, hence, in a general way may be said to have fewer open pathways of release for their primitive impulses at higher socialized levels of reintegration.

As one turns the plates of the atlas of von Economo and Koskinas, augmented by the studies of Rose, Pfeiffer, the Vogts and others, which dimly envisage the integration possibilities of the cortex with its sixty million "centrals," one stands aghast at one's ignorance of what telencephalization really means as to possibilities of socialization of the body's cravings. The greatest number of these are capable of being discharged through symbolic (thought) processes, if the machine is not injured. Who, may it be injected, has really analyzed the machine of any of these encephalitic patients according to the criteria of von Economo and Koskinas? Most of the patients show it in an oculogyric crisis, but what it actually stands for will require a few centuries for interpretation. One thing is evident, that the stickiness of thought is not due only to somatic impairment, any more than are the ocular spasms, for during the intervals in which the patients are well such difficulty does not ensue. Hence, one must conclude that one is also dealing with affective situations, as in many allied compulsion states.

COMPULSIVE AFFECTIVE STATUS AND THOUGHT CONTENT

The affective status is of much significance in these crises, especially in the severer types. In most of the recorded cases, mention is not made of any accompanying affective situation. Others seem to indicate an absence of any accompanying emotional condition, at least it has not seemed pronounced enough to warrant special mention. I believe this is merely superficial observation or recording. The more minutely observed cases, notably those of Ewald (as a type) or of Stern, however, clearly indicate that a real insight into the oculogyric situation is not complete without the consideration of this particular type of phenomenon. As this affective status lies at the nucleus of the compulsive state, and receives special consideration in the psychopathologic interpretation, some description seems desirable. Furthermore, it is a matter of almost universal recognition that the postencephalitic situation, in practically all of its forms, contains emotional (affective)

reactions of almost every conceivable grade, from mild anxieties to grave psychoses. It is no wonder, then, that compulsive-impulsive behavior reactions with decided thought content should be encountered in the specially delimited oculogyric crises.

Stern (1927), in the most complete discussion of these reactions thus far recorded in the literature, opens his penetrating study with Westphal's description of compulsive ideas (Zwangsvorstellungen), and carries it

Fig. 4.—Oculogyric crisis, from Ewald.

Fig. 5.—Myostatic syndrome complex with oculogyric crisis, from Ewald.

as far as "Zwangsvorstellungen, Zwangsgedanken, Zwangsantriebe," through from Westphal to Freud, noting Oppenheim's acute comments on this general type of reaction as seen in "paralysis agitans." Whether Stern is correct in saying that Oppenheim was the only observer to note this correlation may be commented on later. Here, only the actual phenomena are of interest; later their significance and the somatic-psychogenic antitheses, parallels, or evolutionary stage reactions are discussed.

Stern's separation into three groups affords a convenient platform for description: (1) exogenous psychotic reactions of the acute phase of encephalitis; (2) the bradyphrenias of the chronic stages; (3) the characteristic juvenile impulsive behavior reactions, which he would differentiate as "Dranghandlungen" and not "Zwangshandlungen." As later on the fact that these reactions are more intimately related to the stage of integration of the "Super Ego" in the freudian formulation will be discussed, the differentiation of Stern is more descriptive and static than inherently evolutionary and dynamic.

Then Stern would take up the paroxysmal oculogyric crises as special objects of study from the "psychische Zwangsvorgänge" point of view. The exploration of his twenty cases from the psychic point of view, with the others recorded in the abstracts of the literature and the personal cases given, will offer the phenomena concerning the affective situation and the thought content of this section.

Only a few observers have paid sufficient attention to the psychic situation to permit their utilization in this review. I shall start with the earliest of these.

Oeckinghaus' patient was euphoric. Gabrielle Lévy's patient (case 52) cried, was fearful, and feared she was becoming blind. Bruno Fischer speaks only of his cases as "horribly painful." Leroy [56] mentioned only the attacks; the patient found it hard to concentrate (as in many psychoneurotic persons); his personality was imposed on (masochistic). In case 4, the patient would hit people.

Scharfetter's [57] patients (cases 2 and 3) "felt bad"; the patient in case 5 said, "Must pay attention to something, what is it?" Once his attention was directed to his mother's wedding day, once to what side of the room the bed was located.

Bing and Schwartz's patient (in case 2) experienced great anguish; she sought the dark, held herself immobile and reacted to nothing about her.[58]

In Springlova's [59] case, the condition was very "painful." The patient in case 2 of Hohman's series [60] was depressed and hopeless.

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56. Leroy: Spasme du droit supérieur de l'oeil, etc., J. de neurol. et psychiat. **24**:67, 1924.

57. Scharfetter: Zur Symptomatologie des extrapyramidalen Blickkrampfes, Deutsche Ztschr. f. Nervenh. **86**:237, 1925.

58. This is all that Bing and Schwartz say of the "psychic" states, in spite of Bing's statement how important the psychic states are. Bing, R.: Unfallneurologische Bedeutung des prätraumatischen, Schweiz. med. Wchnschr. **56**:1233 (Dec. 25) 1927.

59. Springlova, M.: Contribution à l'étude de l'altération fonctionelles des mouvements conjugés des yeux au cours des états parkinsoniens postencéphalitiques, Čas. lék. česk., 1925, vol. 24; ibid., Rev. neurol. **2**:519, 1925.

60. Hohman, L.: Forced Conjugate Upward Movements of the Eyes in Postencephalitic Parkinson's Syndrome, J. A. M. A. **84**:1490 (May 16) 1925.

Fig. 6.—Fischer's case of oculogyric crisis.

In one of Pascheff's [61] cases, there was loss of memory during an attack. In case 4, the patient had pseudohallucinatory visions during an attack.

In Pappenheim's [62] patient (case 1) there was a feeling of compulsion with pain.

According to Bertolani, the patient in case 1 "felt very badly"; in case 2, was fearful, crying and mute; in case 3, was "desperate," alarmed and cried like a child—it seemed as if he would die—empty in the head—vertigo; in case 5, rigid, as if set, dazed; in case 6, he said, "cannot feel well," "cannot move the 'sense of tension'."

Falkiewicz and Rothfeld [63] spoke of "Zwangsdenken"; the patient in case 2 was "uncomfortable"; in case 3, compulsory thinking came

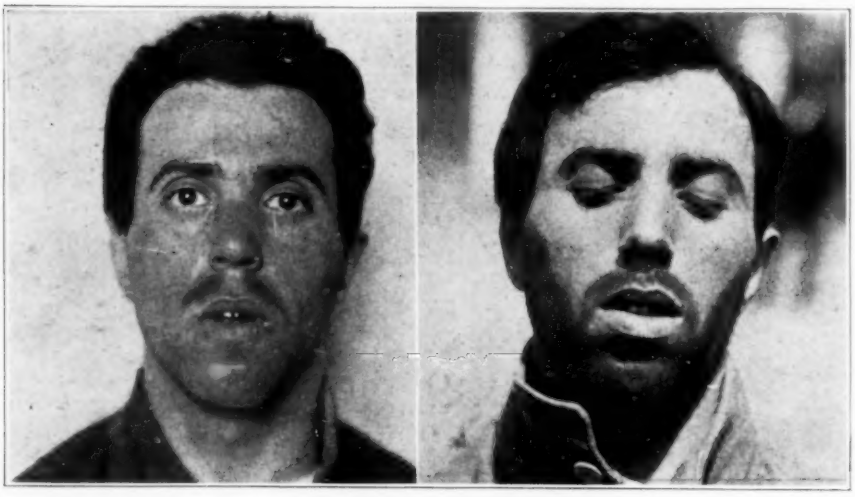

Fig. 7.—Oculogyric crises in one of Falkiewicz and Rothfeld's patients.

to conscious expression—she prayed, "Gegrüst sei du Maria"; all the "A's" had to be as if written, but without writing them, yet the right hand seemed as if it were doing it. The letter compulsions occurred with and without the eye movements and were distressing.

Ewald's six cases are the most detailed in the earlier literature so far as compulsive ideas are concerned (see abstracts, also Dalma's discussion of these cases).

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61. Pascheff, C.: Sur l'ophthalmoplegie nucléaire progressive et en tic oculaire particulière de l'encéphalite lethargique épidémique, Arch. d'opht. **42**:705, 1925; Rev. gén. d'opht. **40**:333, 1926.

62. Pappenheim: Blickkrampf nach oben und unten, Jahrb. f. Psychiat. u. Neurol. **44**:148, 1925; Vertikaler, Blickkrampf bei postenzephalitischen Parkinsonismus, Rossolimo Festschrift, 1925, p. 602.

63. Falkiewicz and Rothfeld: Ueber Zwangsbewegung und Zwangsschauen bei epidemischer Encephalitis, Deutsche Ztschr. f. Nervenh. **85**:269, 1925.

CASE 1.—The attacks were agonizing. The patient was preoccupied with his condition; he was depressed, and grasped only little of what was said to him. "He was going crazy." Letters had to be counted—Were they 7 or 10? The vowels a, e, i, o, u—did they follow regularly, or were they reversed? His attacks began with sadness, his words left him. "Entladung"—a discharge. Then a complex compulsion ensued regarding esperanto vowels and consonants (females and males [psychanalytic conception]); all related to his illness. A sister situation is here relevant from the psychoanalytic point of view.

CASE 2.—Suicidal attempts occurred from the "agony of his eyes"; he saw colored lights, white and yellow; the "eyes seem to get big." He was anxious and obsessed and experienced "duty things." "What the men have," "one could die of such a thought." (This is of special interest psychanalytically.)

In Gründler's [64] case, the patient became moody and quarrelsome; agony and headaches were present. Leone's [65] patient had vague (nonde-

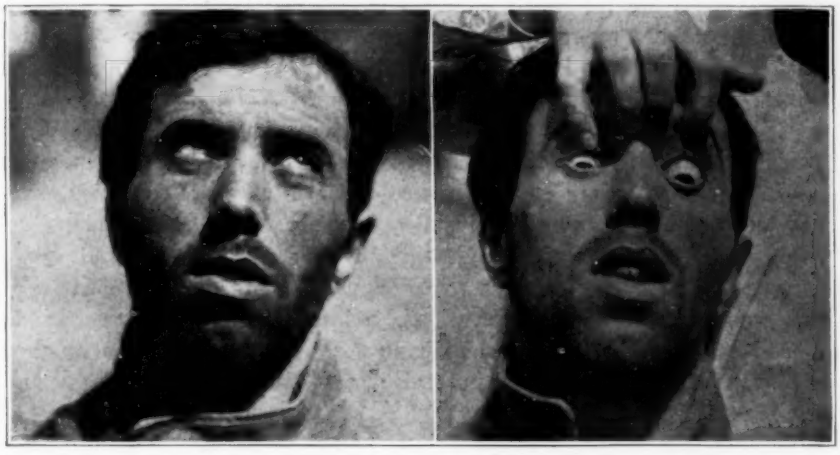

Fig. 8.—Oculogyric crises in another of Falkiewiecz and Rothfeld's patients.

scribable) hypermotivity. In case 1 of Petit, Bauer and Chatagnon [66] there were three suicidal impulses; the patient was conscious and irritable with tickling sensations at the base of the head. In Dupuoy, Bauer and Chatagnon's cases, three patients were suicidal. Tinel and Baruk [67] reported "anxiety states" in their patients. Vivaldo reported a psychotic

64. Gründler, P.: Ueber Schauanfälle bei Encephalitis epidemica, Monatschr. f. Psychiat. u. Neurol. **61**:378, 1926.

65. Leone, F.: Spasmo tonico accessionali nei musculo oculari come postumo di encefalite epidemica, Comm. d. Soc. med. anconetana, Sept. 23, 1923; Spasmo tonico accessionali nei muscoli oculari come posto di encefalite epidemica, Rassegna di studi psichiat. **15**:125, 1926.

66. Petit, Bauer and Chatagnon: Encéphalite épidémique fruste, Encéphale **21**:708, 1926.

67. Tinel and Baruk: Crises toniques oculogyres d'origine encéphalitique, Rev. neurol. **2**:627, 1926; ibid., Encéphale **21**:778, 1926.

case—"obsessive and compulsion"; "mental depression and blocking." Schuster [68] spoke of attacks accompanied by "brüllen" and "squealing like a stuck pig" (compare my case 3).

Van Bogaert and Delbeke reported that crises occurred only at periods when the patient was very angry and were accompanied by blushing, tremors, perspiration on the left side of the body, salivation, urination and apnea. This state may be replaced by a period of intense and unjustifiable fear. (Van Bogaert reports a case supplying direct evidence of one of our contentions in that the speech mechanisms and other movements at times succeed in getting the repressed unconscious material out [68a]).

Barkas' [69] first patient showed great distress with spasmodic laughing and crying; the second patient, suicidal thoughts with emotional distress involving the husband; the third patient, depression.

M. Fischer [70] reported the condition very painful in case 2. Kulkow's [71] patient (case 1) was "sunk in his thoughts." In Marinesco and Radovici's first case, attacks came on when the patient was thinking of the death of the parents; in case 2, the patient experienced severe pains in the neck which she attempted to control by forced movements.

In Laignel-Lavastine and Bourgeois' [72] first case the condition was accompanied by anxiety. Perkins' [73] patient (case 1) was so anxious he could not attend to anything. Georgi's [74] first patient experienced great fatigue and vomiting and was unconscious of the direction of the eye movements. (There were interesting correlations between the attacks and a skin eruption.) In his second case, the patient saw a man on the ceiling with a knife in his hand; also saw "flowers"; he had unconscious periods.

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68. Schuster: Ueber das zwangsweise Brüllen als hyperkinetsches Symptom d. Parkinsonismus, Klin. Wchnschr. **38**:1824, 1925.

68a. Van Bogaert: Sur les modalitiés exceptionelles des crises oculogyres, J. de neurol. et psychiat. **28**:379, 1928.

69. Barkas, M.: Tonic Spasms of the Eyes in Conjugate Deviation, Lancet **2**: 330 (Aug. 14) 1926.

70. Fischer, M.: Der extrapyramidale Blickkrampf als postencephalitische Symptom, Arch. f. Psychiat. **77**:303, 1926.

71. Kulkow: Periodischer Blickkrampf beim postencephalitischen Parkinsonismus, Ztschr. f. d. ges. Neurol. u. Psychiat. **102**:636, 1926.

72. Laignel-Lavastine and Bourgeois: Syndrome excitomoteur cervicofaciale avec crises toniques d'élévation des yeux d'origine encéphalitique, Rev. neurol. **11**: 572 and 574, 1926; Crises de déviation de la tête et des yeux avec regard en haut, etc., d'origine encéphalitique, Bull. et mém. Soc. méd. d. hôp. de Paris **43**:149, 1927.

73. Perkins, O. C.: Vertical Nystagmus with Fixation Phenomena, Am. J. Ophth. **9**:588, 1926.

74. Georgi, F.: Ungewöhnliche postencephalitische Symptomenbilder. (Zugleich ein Beitrag zur experimentellen Erzeugung sogenannte Schauanfälle), Ztschr. f. d. ges. Neurol. u. Psychiat. **106**:602, 1926.

In Tchlenoff and Toulaeva's [75] case the patient became pale and rigid. One of Wimmer's [76] patients (case 1) showed "great distress and had fits of screaming." In case 3, there were compulsive suicidal ideas (two attempts); the patient was forced to look out of the window at the sky; his eyes told him to commit suicide; he was "terribly distressed" and "giddy."

Roger and Reboul-Lachaux [77] reported that one of their patients (case 5) cried during an attack; another (case 7) showed great depression with anxiety and suicidal thoughts. Sarbo's patient (case 1) cried "God, God, now I cannot see!"

Benvenuti [78] reported that there was great distress and pain, also trance states in his first case; much emotional depression in his second case; mental confusion in his third case; confusion and depression in his fourth case, and pain and profound depression with great anxiety in his fifth case.

Catalona [79] reported depression in his cases. In his third case, Mari [80] reported some depression with headache; in his fourth case, extreme suffering, with visual hallucinations of a big black dog that was running by.

Of those who have taken up the consideration of these obsessive ideas in postencephalitic cases, Dalma [81] is one of the few who apparently has any real knowledge of the psychoanalytic literature on the compulsion neuroses. He commented on the general compulsive situation rather than on the special one with which I am dealing. He quotes and abstracts from Meyer—Gross and Steiner, Hermann, Ewald, Falkiewitz and Rothfeld, Bertolani, De Sanctis, Scharfetter, gathering twelve cases from the literature (a small fragment as the abstracts here given show). His first case history is that of a child, 8 years of age, who had exquisite compulsive situations; this will be discussed later even though his condition does not come into the frame of oculogyric crises.

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75. Tchlenoff and Toulaeva: Syndrome postencéphalitique infantile, Rev. neurol. **1**:563, 1926.

76. Wimmer (footnote 7, second reference).

77. Roger and Reboul-Lachaux (footnotes 14, 40 and 41).

78. Benvenuti, M.: A proposito di alcuni casi di encefalite epidemica cronica con manifestation coatte accessuali della motilita, Cervello **6**:177, 1927.

79. Catalona, A.: Sindromi parkinsoniana con crise oculogyri tonico clonico e retropulsione spontanae, Cervello **6**:2, 1927.

80. Mari, A.: Manifestazioni coatte accessuali della motilità in post encefalitici parkinsonsimili, Cervello **6**:313, 1927.

81. Dalma, E.: Considerazioni intorno ad un caso di ideazione coatta in fanciulla postencefalitica, Cervello **6**:65, 1927.

Pardee's [82] patient (case 4) had "stormy hypomanic moods." Wilder and Silbermann's first patient showed "anxiety, depression and a sullen mood"; but when he was kissed and caressed by his fiancée the attacks ceased. The patient in their fourth case showed anxiety and a slowed mental reaction.

Skalweit's [83] patient (case 1) sought out bright things—he resisted the compulsion by opposite movements. He said that he "must look at the ends of grass blades," and compared this to the desire to scratch an itchy spot. The patient in Williamson-Noble's [84] third case said that she had dreadful thoughts during the attacks which she could not relate.

This rapid summary of the anxiety states observed during these crises is all too fragmentary. As may be noted, Stern's studies are the

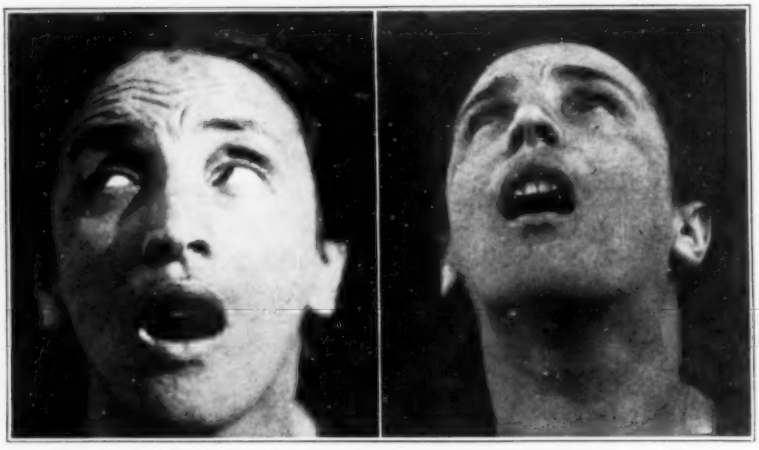

Fig. 9.—Oculogyric crisis in Mari's case.

most vital and hence are placed here at the end with comments on the affective state and its related thought content—as may be available. As it usually takes much time to work out this thought content, it is little wonder that few satisfactory observations are on record.

Bing, in his paper on "spasms" and "tics," utilizing encephalitic material, raises several important issues, none of which, however, are specially new. He speaks of the "herrschende Dogma" of the psycho-

82. Pardee, I.: Paroxysmal Oculogyric Crises in Parkinsonian Encephalitis, Am. J. M. Sc. **175**:683, 1928.

83. Skalweit, W.: Ueber Zwangsantriefe und psychische Zwangszustände im Gefolge der Encephalitis epidemica, Monatschr. f. Psychiat. u. Neurol. **67**:11, 1928.

84. Williamson-Noble: Encephalitis: Ocular Complications, Proc. Roy. Soc. Med. **21**:987, 1928.

genic nature of all tics. My experience is that the "prevailing dogmas" are quite to the contrary; the medical world at large has but the faintest conception of things psychologic. The fancied dangers of this "psychologizing tendency" Bing would exemplify in the report of the suicide of a young man who had a severe facial tic and who was treated unsuccessfully by a "berühmten Psychotherapeuten." At autopsy it was found that he had a meningeal thickening pressing on the seventh nerve. (How this caused a tic is still to be explained.) On the other side of the picture there are many records of suicides among patients who were treated by surgical measures for supposed somatic situations, and at autopsy such organic lesions were not demonstrated. Ergo, is it good logic to condemn "a berühmter Chirurge" or other related therapist on the basis of this experience? It seems that Bing's argument throughout misses the entire situation. In the first place, he talks about "names" instead of processes. "Hysteria" is anything psychogenic. No student oriented to the present day aspects of the hysteria problem has such naive notions as Bing bravely tilts at. "Hysteria," or rather the "conversion of libido through somatic discharge," is a specific situation, relevant to a definite task of the individual. Lacking the precise situation in any case of such a purposeful economic bit of dynamics, "hysteria" is not hysteria, hysterical or hysteriform. Bing shares with many another this foggy notion of the dynamic hysteria concept.

His discussion of the various tic or cramp movements in encephalitic patients, notwithstanding this naive affective attitude toward psychogenesis, is particularly valuable. He takes up the facial, tongue, chewing, respiratory, eye muscles, neck and trunk, extremity and generalized movements. It is an excellent résumé. Nowhere, however, in any one case does one find a detailed study of any one of the movements to indicate why the patient made it. Bing is satisfied to call it or them "release" phenomena. "Release of what" he does not tell except in a footnote of negative criticism of what he falsely conceives the psychoanalytic situation to be. Clever and astute as he is to envisage the enormous phyletic complexities of motor coordinations, one suspects an equivalent density or rather resistance concerning the comprehension of the even more difficult and subtle phyletic complexities of affective states. The synthesis of the affective life from protozoa to man, because it must be read in the colossal mass of cultural achievement, lacking structural (i.e., anatomic) substrata, requires an abstractive capacity akin to poetic genius. Bing does admit what he calls "psychical impulse" release, but he does not advance beyond parallelistic conceptions. To speak of "psychical impulses" as simple entities, as for instance Stern also does when he regards "affectivity" as a primary unanalyzable situation, is in my opinion naive. Throughout this entire argument, Hughlings Jackson's penetrating glimpses into what he called

the "positive" symptoms seen in dissolution of function are totally ignored. To quote Steck, as late as 1922, as first showing parallelistic phenomena is much behind the times. I am much in sympathy with Bing's statement that "Psychisches und anatomisch-physiologisches gleichmässig beherrschende, neurologische Ausbildung" is necessary. My only comment on this is that whereas he is sound concerning what a neurologic foundation may mean, I believe that he has really little comprehension of what a "psychisches Ausbildung" entails. It is an "Ausbildung" infinitely more complex and difficult to obtain than any "neurologisches Ausbildung." Expressed in a crude proportion, I believe that "as arithmetic is to calculus, so is neurology to psychiatry." Kappers' great treatise on the "Comparative Neurology of the Nervous System" is an A, B, C, to what some thousands of years from now will be understood as the comparative psychology of living organisms. Freud's work is but the beginning of this elaborate synthetic structure.

It sounds well to speak of the "striatum" as a "center for complex psychical functions," as Bing and Stern and all the others do, twenty or more of whom might be cited; they seem wise when they say this, but what does this really mean? Why limit such affective functions to the striatum? Are not all of the diencephalic structures correlating mechanisms for "feeling" attitudes? The situation is by no means so simple even if one takes in the correlating neurons of the optical and auditory pathways of the geniculate bodies. And what about all the discussions of Tanzi, Lugaro and others anent the deeper (vegetative) layers of the cortical complexes?

After all, what are the "affective functions," phyletically speaking? Even if the poet Schiller reduced them all to "Hunger und Liebe," are not hunger and love vast phyletic syntheses in which every organ of the body participates? Is there not an oxygen hunger, an iron hunger, a phosphorus hunger, a calcium hunger, as well as other forms—but why go on? The human body has twenty-eight elementary chemical hungers, not to mention the million or more permutations of these. Is love any less complicated as it has built up behavior during the billion years of social reproduction on this globe?

When one commences to think along such lines, one sympathizes with Shakespeare when he wrote "Law is an Ass"; and one might wish to paraphrase the comment in the same frame of reference by saying "Medicine is a donkey"?

As already noted, Stern is one of the few who would attempt the study of the affective situation seen in these oculogyric crises. It is well understood that this evaluation belongs in a larger frame and can be extended to the whole postencephalitic situation to great advantage, as many authors have already attempted, notably Kleist, Goldstein, Bing, Steck, Hauptmann, Gerstman and Schilder and others. My own contributions to the respiratory and psychotic pictures have been referred to.

Stern is more frank than many another writer, for he acknowledges that his study is undertaken "ausser psychische Analyse." Yet even with this gesture of excuse or irony—one is not certain which—he endeavors to enter the analysis of the "affective state."

His case histories are considered elsewhere in this study and only certain comments will be discussed. His experience is evidently the greatest of any of the students of the present day. At least twenty cases offer him an excellent background, and even if only a few of them are given in fragmentary detail, yet they are of great value, bearing on the phenomenology as well as offering something for later interpretation.

The first patient whose case he reported had to fix her eyes and her ideas on a certain *"point"* (italics mine). (This may be compared with other compulsions: "sharp points," "blades of grass," "what men have," "don't touch me.") The patient knew it was nonsense; but why was the "*O* round"? "The patient was as one dying." As in my case of J. F., the fatty and tear secretions increased (vasomotor congestions). She said that "her body got bigger and that she wanted to experience pain in order to verify her being." Here Stern acknowledged "sexual" factors—but probably would repudiate what may be guessed at psychoanalytically—"body bigger," "wants to experience pain"—as a possible *birth fantasy*. He did not make any real study about the meaning of all this as an analyst would.

The patient in case 2 had impulses to say nonsense and obscenities. Stern says that there were no sexual thoughts, but Stern evidently does not distinguish between "genital" and "sexual."

In case 3, the patient said, "Get away Satan, Jesus is mine," and had ideas about Ü because Ü is in Sünde. Stern apparently was really not curious as to what the correlation of Satan and Sünde may stand for, even though one might assume that he had some acquaintance with the "Garden of Eden" and Satan and Sünde (sin).

The patient in case 4 was a physician with a "vertiginous syndrome," who was also very anxious, but what "vertigo," "falling" and other symptoms may stand for psychologically is not inquired into.

A fifth patient felt that he must count from 1 to 100 compulsively. There were no comments on what this might possibly stand for.

Stern's comments on the "anxiety" situation will be commented on more in detail when the psychopathologic conceptions are discussed. All that is necessary to record here is that Stern seriously stated that "anxiety" is a primary symptom and is unanalyzable. As the psychoanalytic school [85] has been studying "anxiety" intensively for a number of years, this position taken by Stern cannot be seriously accepted.

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85. Freud: Inhibition, Symptoms and Anxiety, Tr. by L. P. Clark, Hartford, Conn., 1928.

Disturbances of consciousness are presented in a separate chapter of this study.

ABSTRACT OF DISCUSSION

DR. J. F. FULTON, Boston: Has there been a history of diabetes insipidus in any of the cases of postencephalitic oculogyric crises?

DR. JELLIFFE: None of my own patients had diabetes insipidus. Polyuria is a not infrequent symptom in encephalitis and is frequently reported for these patients. Polyuria and tuber cinereum or other diencephalic nuclear involvement are related in some manner. (See studies of Dresel, Levy and others.) In most of my cases there was a certain amount of polyuria, mainly because they nearly all showed a great polydipsia. They were drinking all the time; therefore, there was an enormous amount of urinary output. Whether that urinary output has ever been actually mensurated with the water intake, I cannot say, but in the 200 cases that I have here digested, speaking of the oculocephalogyric cases alone, there are numerous cases of polyuria.

DR. T. DILLER, Pittsburgh: Are these movements shown on the screen considered akin or somewhat like those of dystonia musculorum? They are somewhat similar to my mind.

DR. JELLIFFE: I can answer that only in the sense that, as I have already outlined, these oculogyric movements have been seen in a number of other situations, but I have not seen them in their paroxysmal nature in a single case of ordinary dystonia musculorum. It is not at all impossible that they would be found, since the dystonia picture can be one of the developments in the ordinary evolution of postencephalitic parkinsonism. Many cases of dystonia musculorum are probably postencephalitic parkinsonism and, therefore, there is no reason why the eye movements should not occur. If I am correct, some spasmodic eye movements were described in Gamper and Untersteiner's interesting case. Zingerle's studies also showed approaches to the situation.

DR. COLIN RUSSEL, Montreal: This paper recalled to my mind one patient of mine who always came into the clinic with a little peaked cap on. One day I asked him why he did this. "Well," he said, "it keeps my eyes down." And, sure enough, as soon as one took his cap off, his eyes turned up to the ceiling. When he put his cap on again, they came down. I have had two or three cases of this nature, but I have never attempted to explain them on any psychologic complex.

DR. JELLIFFE: I might parenthetically add with reference to Dr. Russel's comment, that the "peak" on the cap might have hid his censorship and got the policeman out of the way temporarily. When the policeman was removed, then up went the eyes.

I had hoped that some of the gentlemen here might have discussed the French doll movements and a number of situations of that kind. Some others might have discussed the early observation of Bell, with which we are familiar, to the effect that when we go to sleep our eyes turn up, etc. I had hoped that some gentleman of artistic interest might have talked about the pictures of the middle ages in which Transfiguration and the Crucifixion were the subjects. Witness the so-called epileptic boy in Raphael's Transfiguration with classic oculocephalogyric eye positions. I hoped also that somebody here might have said something about ecstasy and adoration, and all of that type of related material which any brief glance at some of the pictures might have suggested. All those things, however, are discussed in my paper.

CALCIFICATIONS IN THE CHOROID PLEXUS WITH CONSIDERATION OF THEIR SIGNIFICANCE*

ERNEST SACHS, M.D.
AND
CAROLINE WHITNEY, M.D.†
ST. LOUIS

Last summer, one of us (C. W.) observed at the Colorado Psychopathic Hospital, on the service of Dr. Franklin Ebaugh, the case of a microcephalic idiot who on roentgen examination showed extraordinary calcification in the choroid plexuses. This case is being reported by Dr. Fox and one of us (C. W.). Through the kindness of Dr. Ebaugh, the patient was sent to St. Louis for study.

REPORT OF CASE

The patient, aged 18, was a microcephalic idiot (figs. 1 and 2) with moderate intelligence, and would be classed as a high grade imbecile; he had spadelike fingers, prominent teeth and a profuse growth of hair on the body. Both femurs and humeri were longer than they should have been for his height. This was the only abnormality in the bony framework that was noted aside from that of the head. Neurologically, the examination gave negative results. The excessive growth of hair suggested the possibility of a pineal factor in the case, but there was no history of early sexual development nor any other evidence pointing to a pineal lesion.

COMMENT

The points that have interested us are: (1) the relation of the calcifications, shown by roentgen examination to be present in both lateral ventricles (figs. 3, 4 and 5) and in the third ventricle, to the production of cerebrospinal fluid; (2) the possibility of demonstrating that the form of microcephalus in this boy was different from that found in the ordinary microcephalic person and (3) the significance of calcification in the choroid plexus.

The literature on calcifications in the choroid plexus is rather meager. Standard textbooks of pathology do not contain a description of extensive calcification of the choroid plexus. In speaking of tumors of the choroid plexus, Ziegler (1896) [1] said: "Fibromata, lipomata, chon-

* Submitted for publication, July 5, 1928.
* Read by title at the Fifty-Fourth Annual Meeting of the American Neurological Association, Washington, D. C., May, 1928.
† Dr. Whitney died, July 13, 1928.

1. Ziegler, Ernst: Text-Book of Special Pathological Anatomy, translated and edited from the eighth German edition by MacAlister and Cattell, New York, The Macmillan Company, 1896.

dromata, and osteomata are very rare." Adami,[2] Ziegler,[1] McCallum,[3] Stengel,[4] and others mentioned the frequent occurrence of small calcareous deposits, commonly known as corpora amylacea or "brain sand," in the choroid plexus. Virchow [5] and Haeckel [6] were probably the first to mention these small concretions in the literature. All agree that their incidence increases with age. They are microscopic in size, and no instance is given in which they have assumed such proportions and

Figure 1

Figure 2

Fig. 1.—Front view of patient, showing strikingly long arms and short legs.

Fig. 2.—Side view of patient, showing strikingly long arms and short legs.

2. Adami: Principles of Pathology, Philadelphia, Lea & Febiger, 1910.

3. McCallum, W. G.: A Text-Book of Pathology, Philadelphia, W. B. Saunders Company, 1916.

4. Stengel, Alfred: Text-Book of Pathology, Philadelphia, W. B. Saunders Company, 1903.

5. Virchow, R.: Handbuch der speciellen Pathologie und Therapie, Erlangen and Stuttgart, 1854.

6. Haeckel: Pathological Anatomy of the Choroid Plexus, Virchows Arch. f. path. Anat. **16**: 253, 1859.

density as to throw a shadow similar to the one seen in the case presented although, according to Ziegler, "the brain sand may be so increased that the plexuses are visibly enlarged and turn an opaque white."

Bland-Sutton referred to the frequent occurrence of calcifications in the choroid plexus of horses. His statement was based on an article by John Gamgee,[7] published in 1852, in which the author discussed at some

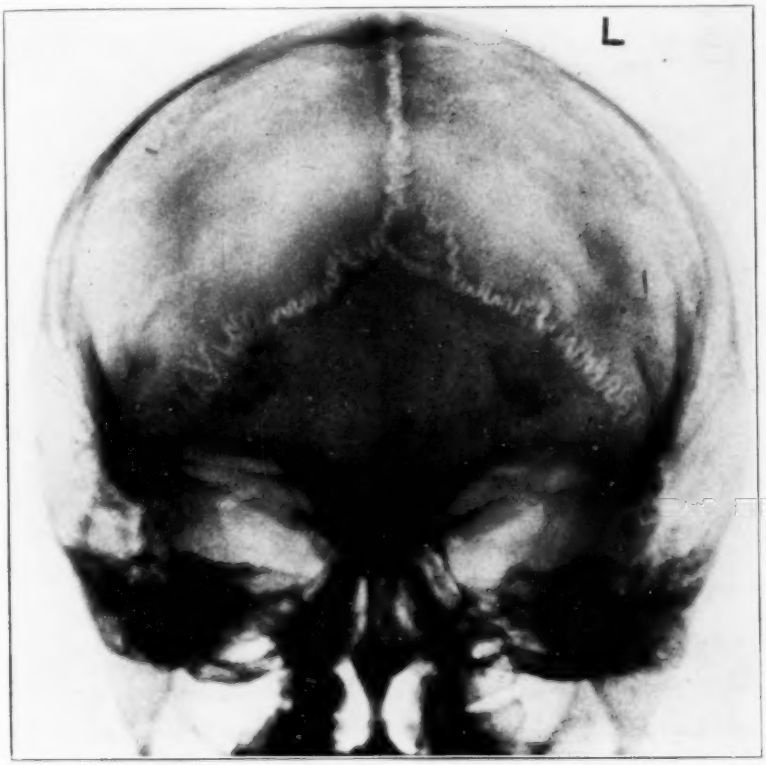

Fig. 3.—Roentgenographic appearance of calcifications.

length bodies the size of a nut that he found in the choroid plexus of horses. From the description, there can be little question that these were cholesteatomas.

Calcification is known to occur in degenerating areas of tumors. Davis and Cushing (1925),[8] who reviewed the subject of tumors of the choroid plexus, found that true tumors of the plexus are extremely rare;

7. Gamgee, John: Adventitious Products of the Choroid Plexus, Veterinarian **63**:144, 1852.

8. Davis, L. E., and Cushing, Harvey: Papillomas of the Choroid Plexus with a Report of Six Cases, Arch. Neurol. & Psychiat. **13**:381 (June) 1925.

only twenty-five cases were reported previous to 1925. The reviews of Audrey (1886) [9] and of Boudet and Clunet (1909) [10] included many tumors of the region of the choroid plexus as well as true tumors of the plexus. Only two of these cases showed gross calcification, although "brain sand" is of common occurrence. In the brain of a girl dying of scarlet fever, Boscredon (1855) [11] found in the course of an intense chorea two small tumors which seemed to arise from the choroid plexus. Unfortunately, the original article does not give a more complete descrip-

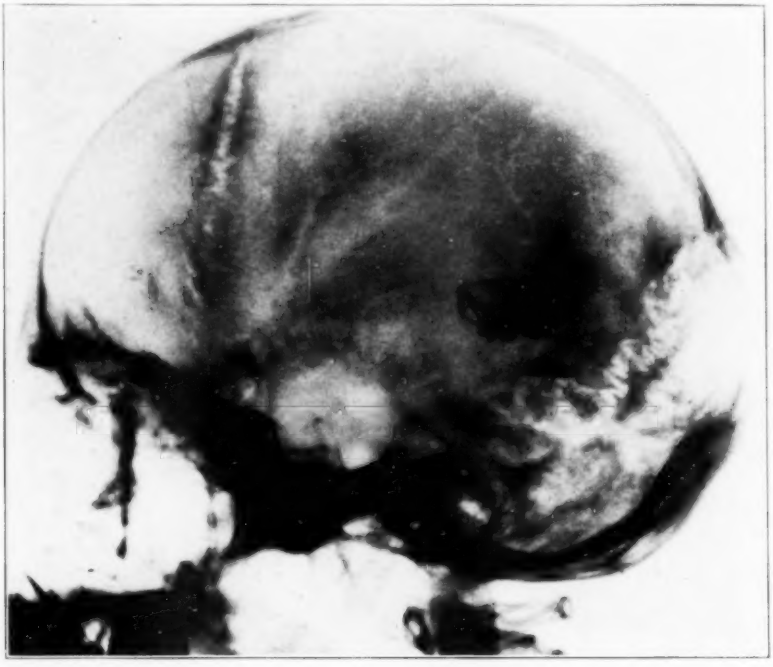

Fig. 4.—The calcifications seen in figure 3 are superimposed so that there appears to be only one.

tion. Broca and Bonnet (1861) [12] reported the occurrence of an osseous tumor in the choroid plexus of a woman, aged 40, who had been affected with left hemiplegia since infancy. Shortly before death, she was subject to epileptiform convulsions. Autopsy revealed a bony mass weigh-

9. Audrey, J.: Tumors of the Choroid Plexus, Rev. de méd. **6**:897, 1886.

10. Boudet, G., and Clunet, J.: Contributions a l'étude des tumeurs épithelials primitives de l'encéphale, Arch. de méd. expér. et d'anat. path. **22**:379, 1910.

11. Boscredon: Bull. Soc. anat. de Paris **30**:199, 1855.

12. Broca, presenté au nom de Bonnet, H.: Une tumeur osseuse des plexus choroides, Bull. Soc. anat. de Paris **36**:505, 1861.

ing 25 Gm. in the right lateral ventricle. In the opinion of Broca, this originated from the choroid plexus. No other cases of gross calcification are reported in the literature. In the case reported by Burmeister (1915),[13] the choroid plexus was the origin of a mixed tumor (chondrofibro-epithelioma) in which calcareous granules, "brain sand," occurred. Cartilage was present, but calcification of this cartilage was not specifically described, and uncalcified cartilage would not show a shadow on the roentgenogram.

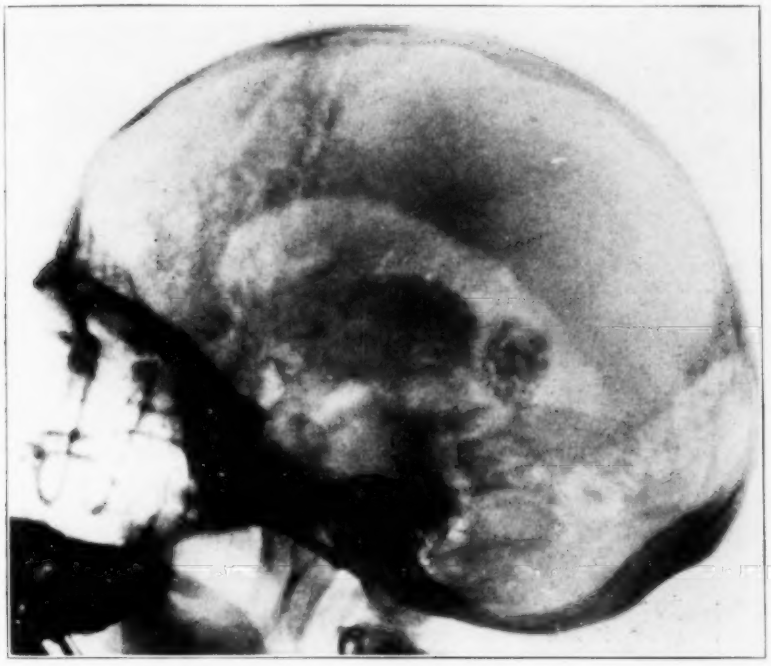

Fig. 5.—Calcification is seen to lie in the ventricle, which is distended with air.

The view generally accepted today is that the cerebrospinal fluid is produced in the choroid plexus; whether it is an exudate or transudate is still a question under discussion, but that all or most of it comes from the choroid plexus seems certain. There has never been a thoroughly satisfactory explanation of what factors play a rôle in keeping the fontanels open during the first two years of life. The actual increase in brain volume is undoubtedly an important factor. This, however, may not be the only factor, and it seems quite likely that the pressure exerted by the distended ventricles may also play a rôle in keeping the

13. Burmeister, W. H.: A Mixed Tumor of the Choroid Plexus, Bull. Johns Hopkins Hosp. **26**:410, 1915.

fontanels open while the brain is growing. If this pressure is absent, the fontanels may close early and a microcephalic head result. Therefore, when the plexus is removed or thrown out of function, this factor which tends to make the head enlarge during childhood is removed. In microcephalism, agenesis of the cortex, which results in microgyria, is ordinarily present. These large masses in the choroid plexuses must

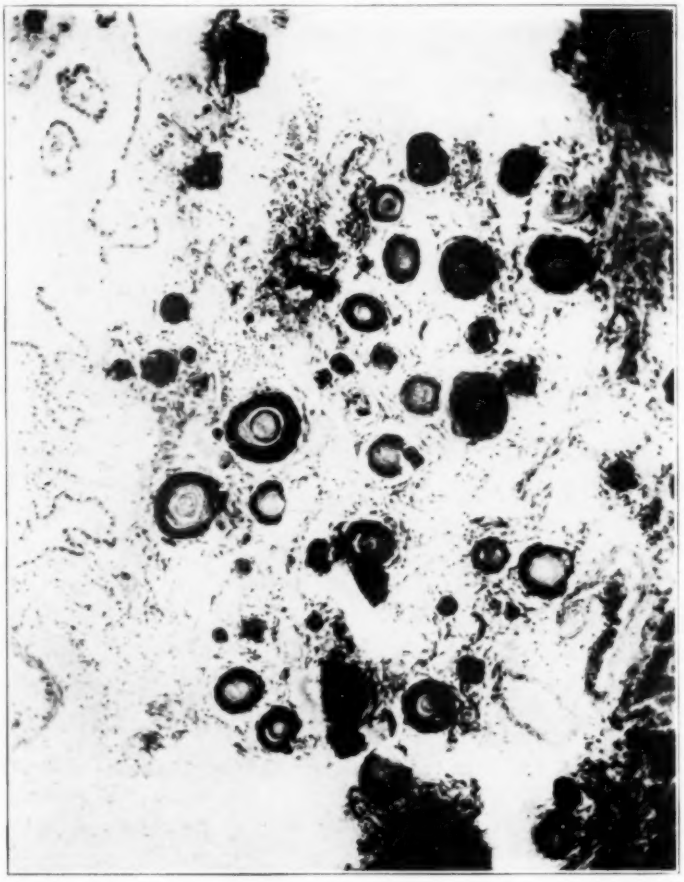

Fig. 6.—Typical appearance frequently found in a choroid plexus in an adult. Numerous corpora amylacea.

interfere with the production of cerebrospinal fluid, and, consequently, it was a matter of great interest to know if this microcephalic child had microgyria; if not, it would tend to confirm the idea that the production of cerebrospinal fluid was a factor in growth of the brain. To determine this, we made an injection of air into the spine to see if we could learn the shape of the convolutions from the collections of air in the sulci. For

purposes of comparison, injections of air into the spine were also made on four microcephalic idiots at the City Sanitarium in St. Louis. In the case showing calcifications, air did enter the subarachnoid space. These spaces appeared far enough apart to resemble the picture of air in the sulci of a normal cortex, and the picture did not resemble in any way the type of picture one would expect to see when air filled the sulci of a

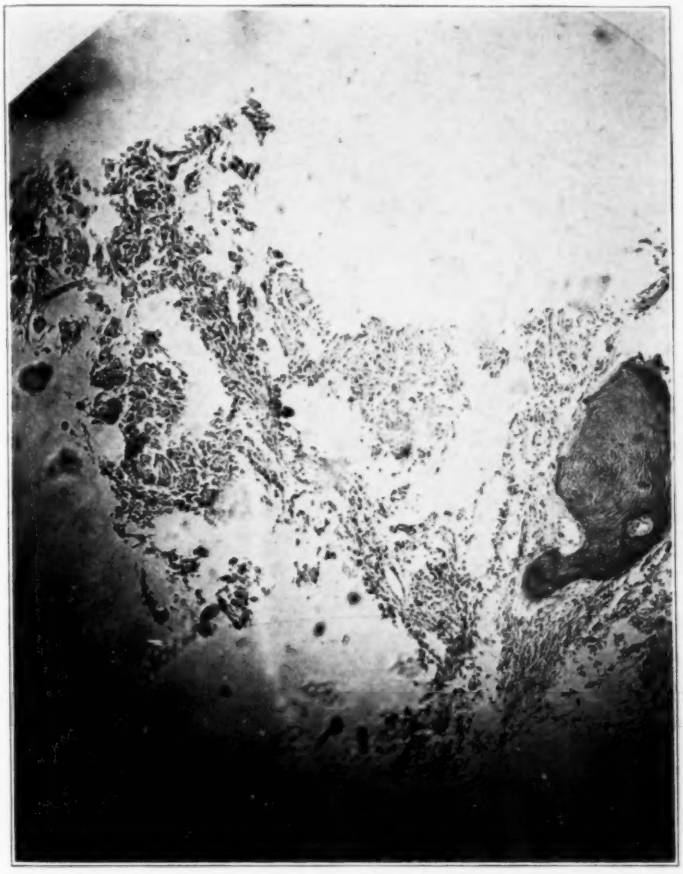

Fig. 7.—A deposit of bone found in the choroid plexus during a routine post-mortem examination.

microgyric brain. In the four microcephalic idiots, air was not seen over the cortex. Whether this was due to blocking of the subarachnoid space or to faulty technic was not certain, but there was a difference between these cases and the case showing calcification.

It seems possible, therefore, that the small size of this boy's head was due to diminution of function of the choroid plexuses rather than

maldevelopment of the convolutions. Furthermore, we would suggest that injection of air into the spine might be used to determine the shape and size of the convolutions. This case also brings up the question of the significance of calcifications in the choroid plexus and whether the masses noted in this case are merely an excessive production of the "brain sand" so commonly found in the choroid plexus (fig. 6) or whether this is a true tumor.

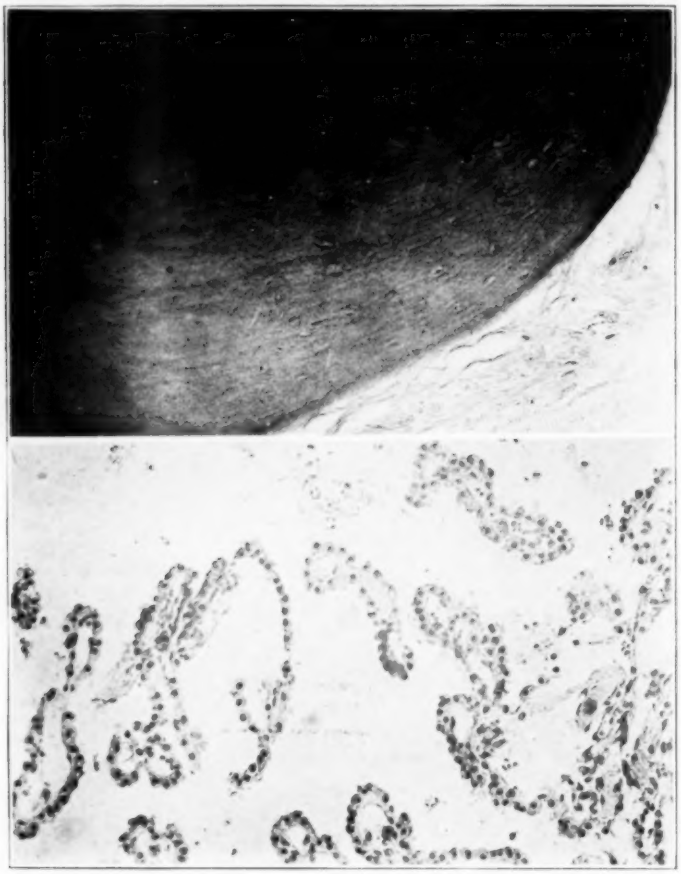

Fig. 8.—A deposit of bone found in the choroid plexus during a postmortem examination.

Virchow and Haeckel believed that calcifications in the choroid occur in older persons and are comparable to calcifications in other organs, especially in the blood vessels. We have examined seventy-five choroid plexuses of patients dying from a great variety of diseases. In these, corpora amylacea were found in 66.6 per cent. Strangely enough, in the literature only occasional mention is made of finding bone in the

choroid plexus (fig. 7 and 8); we have found it twice in the seventy-five specimens we have examined, and one wonders if it may not occur far more frequently and if it would not be detected if a routine examination of a large series of plexuses was made. While slight calcifications of the choroid are commonly recognized in roentgenograms, we have never, in many hundreds of roentgenograms of skulls, seen anything suggesting bone. Most authors seem to believe that the deposit of calcium and the deposit of bone occur under similar circumstances. This is so in the case of arteriosclerotic blood vessels which occasionally contain bone in their walls.

In the case cited there is nothing in the general metabolism to indicate that circumstances are favorable for abnormal depositions of either calcium or bone. The calcifications appeared in a young person who did not show any evidence of unusual calcium deposits elsewhere in the body.

It might be that the deposit of calcium at an early age had acted as a nucleus about which increasing quantities have been deposited in a manner similar to the formation of bladder stones and gallstones. In both the urinary bladder and the gallbladder, the stones frequently have a nucleus of bacterial origin; possibly this may be the case also in the choroid plexus, and the presence of calcifications may be merely an attempt of the choroid to filter out substances, bacteria or some toxic material, which become a nucleus about which calcium is deposited.

SUMMARY

This unusual case is reported because it suggests several interesting possibilities:

1. One of the factors influencing the enlargement of the brain is the production of cerebrospinal fluid.

2. If air is introduced into the subarachnoid space, it may be possible to gain more light on the configuration of the convolutions.

3. The calcifications in the choroid plexus are formed about substances which the choroid has filtered out and which have been prevented from getting into the cerebrospinal fluid.

THE NERVOUS DISEASES OF THE CHINESE*

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PEKING, CHINA

There is a general impression in America and Europe that the Chinese are a self-restrained, unexcitable people, that they "have no nerves" and that consequently they are not subject to functional or even to organic nervous diseases. Even in medical literature generalizations have appeared to the effect that this or that nervous disease does not occur in China. As a rule, these statements are based only on the experience of the particular writer, and indicate merely that patients with the disease in question have never appeared, or have never been properly classified, in the hospital from which he writes.

The masses of the Chinese are ignorant of the aim of scientific medicine and of the advantages of entering a hospital for treatment. Furthermore, outside of a few missionary hospitals, there are extremely few physicians in the villages or even the large cities who could recognize a disease of the nervous system as such, and none who would think of referring the patient to a hospital for care. As an example I may cite a well-to-do family of Peking, the members of which knew of the Peking Union Medical College Hospital and were favorably inclined toward it; but, this family, though living within a few rods of the hospital, cared for their father, a paretic dement, at home during three years. When asked why they had delayed so long before bringing the patient to the hospital, their reply was, "We didn't think of that." For these reasons, hospital statistics, even in the most favorable situations in China, are of small value as indexes of the frequency of diseases.

Information on the nervous diseases of China is meager. Jefferys and Maxwell's work, "The Diseases of China," which was published in 1910, summarizes the experience of missionary and Maritime Customs physicians up to that date. *The China Medical Journal,* the *National Chinese Medical Journal* and the now steadily growing number of papers contributed by physicians in China to the medical periodicals of Europe and America, are giving valuable information on the relatively few cases that have thus far come to the clinics of western-trained physicians.

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MATERIAL

The present report deals with a series of 4,000 neurologic cases studied in the Peking Union Medical College. So small a number is insufficient to sustain any inferences as to the proportionate incidence of the various nervous conditions and, for reasons already stated, the paucity or absence of cases of particular diseases in this series does not indicate that such diseases are nonexistent or even infrequent in China. Yet the report may have some value as supplying positive information regarding certain forms of nervous maladies as studied by a staff of neurologists under the most favorable conditions as to hospital facilities, laboratories and consultants.

One wonders at the outstart whether the eight millenniums or more that separate the Chinese genetically from European stocks have sufficed to permit any observable divergence in the form or the functions of their nervous organs as compared with ours. Dercum,[1] von Bonin[2] and Schuster[3] gave descriptions of Chinese brains in which minor variations in surface markings were found. Kappers[4] compared three Chinese brains with three Dutch brains and found the same average ratio in each triad between (*a*) the weight of the whole cortex and that of the decorticated hemispheres, (*b*) the weight of the whole hemispheres and that of the entire body and (*c*) the weight of the entire encephalon and that of the whole body. Although the hardening had not been satisfactory, he concluded that in the small number of Chinese brains studied the anteroposterior dimension was shorter and the height greater than in Dutch brains, and that the anterior angle between the brain stem and the base was smaller. Thus, the Chinese adult brain, Kappers concluded, resembles that of the Dutch new-born infant. This conclusion was given in a lecture at Yale in 1928.

In the neurologic laboratory of the Union Medical College in Peking, routine study of 300 Chinese brains has not shown any significant variations, gross or microscopic, from European brains, either in normal or in pathologic anatomy. A special study of the gross dimensions after hardening in situ was not undertaken in these cases.

Observation on the Chinese, whether in health or disease, made by the staff of the Department of Neurology of the Union Medical College, has not shown any important differences between them and ourselves

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1. Dercum, F. X.: A Description of Two Chinese Brains, J. of Nerv. & Ment. Dis. **16**:421, 1889.

2. Von Bonin, G.: A Curious Asymmetry in the Chinese Brain, China M. J. **38**:561, 1924.

3. Schuster, E. H. S.: Descriptions of Three Chinese Brains, J. Anat. & Physiol. **42**:351, 1907; **43**:59, 1908.

4. Kappers, C. U. A.: The Relative Weight of Brain Cortex, J. Nerv. & Ment. Dis. **64**:113, 1926.

in the physiology of the nervous system. Their vital centers maintain the body temperature and the pulse and respiratory rates at the same points that are observed in western persons. Their average blood pressure [5] and their average basal metabolic rate are lower than in Europeans and Americans; but the difference for each average is small and falls well within the limits of the variation observed among individuals of other races.

The proportion of neurologic to general patients in the Peking Union Medical College Hospital during the period covered by this report was 5 per cent. Seventy per cent of the neurologic patients were males; 30 per cent were females. Seventy-one per cent of the males and 70 per cent of the females were married. Of those over 20 years of age, 81 per cent of the men and 84 per cent of the women were married.

ORGANIC NERVOUS DISEASES IN CHINESE PATIENTS

DYSPLASIA AND DYSTROPHY

Myopathic Amyotrophy (Essential Muscular Dystrophy).—The incidence rate of this disease was 150 *N*, 7.5 *G* and 33 *A*.[6] All the patients were males. In only one case was a history of the disease in another member of the family acknowledged. The Chinese, however, are reticent in regard to reporting such facts, so that familial incidence may be more frequent. The observed types of this disease (figs. 1 to 3) conformed with the classic types of other countries both in symptoms and in manner of development.

Myotonia Congenita.—This condition was seen in only one patient, a farmer, aged 28, who had first noted inability to relax the muscles of his hand when he was 18 years old. The electrical reactions and the course of the disease were typical.

Spina Bifida.—The incidence rate of this disease as seen in the hospital was 178 *N*, 9 *G* and 44 *A*.[6] Some of the patients with spina

5. Tung, C. L., showed that of forty-eight Americans examined in America and again after three years' life in Peking, 64 per cent showed a decrease in blood pressure. This points to an environmental factor as the cause of the lower pressure in both Chinese and Americans (Arch. Int. Med. **40**:153 [Aug.] 1927).

6. For convenience in comparison with other statistical tables, these numbers are calcuated as ratios per hundred thousand patients. "150 *N*" means there were in the Peking Union Medical College Hospital 150 patients with muscular dystrophy per hundred thousand neurologic cases; "7.5 *G*," that their proportion to the general hospital patients was 7.5 per hundred thousand, and "33 *A*," that in three large American general hospitals, from which statistics were available at the time of the writing of this report, there were 33 patients with muscular dystrophy per hundred thousand general medical and surgical patients.

Fig. 1.—Myopathic amyotrophy. The onset occurred in infancy. The patient never walked. He died in his eighteenth year.

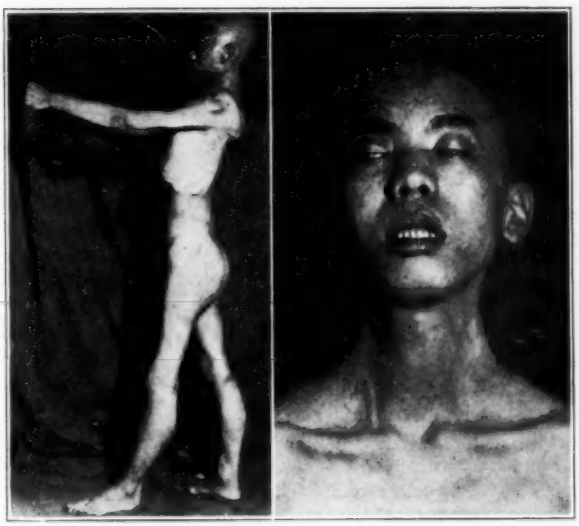

Fig. 2.—Myopathic amyotrophy, juvenile form. The onset occurred at the seventeenth year.

bifida gave interesting evidence of the primary fault in neural development that underlay the mesoblastic maldevelopment.

An infant, who died at the third week, showed moderate hydrocephalus and cerebellar hypoplasia, with a corresponding failure in the pars basilaris pontis; gross heterotopia of the cerebellar tissue in the fourth ventricle and the medulla oblongata, and a tumor-like mass of undifferentiated cells of the ventricular matrix that had failed to migrate. The greater part of the medulla oblongata was included

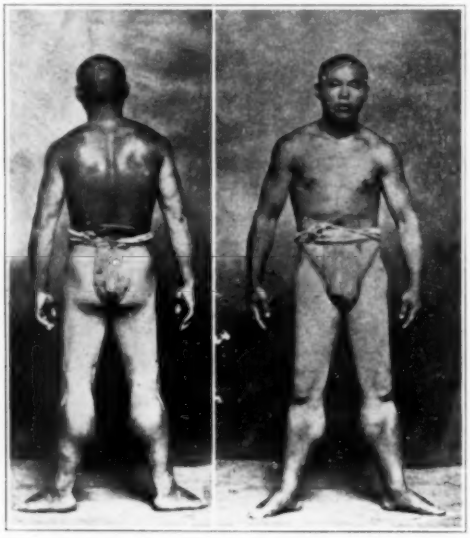

Fig. 3.—An unusual pseudohypertrophy in muscular dystrophy.

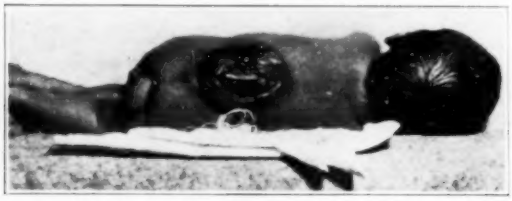

Fig. 4.—Encephalomyelodysplasia, with spina bifida, meningocele and retroanal tumor.

within the cervical vertebrae. The thoracic spinal cord was poorly developed and dwindled into a flattened mass of fragmentary elements of spinal cord tissue, which disappeared entirely at the lumbar level. The vertebrae showed the usual interruption of development. A deep pit with hypertrichosis was present over the sacrum and the coccyx, and a mixed pedunculated tumor was attached posterior to the anus (fig. 4).

A Chinese boy, aged 13, showed marked bilateral weakness of the muscles of the thighs, so that he could not rise when squatting on the floor. There was not,

however, any sign of disease in the pyramidal or sensory tracts. The laminae of the lower lumbar and upper sacral vertebrae were ununited (spina bifida occulta with amyotrophy).

An adult male (fig. 5) had clubfoot and dystrophy of the bone, muscle and skin, together with sensory and motor dysfunction, manifested in enuresis and other conditions.[7]

Keratosis Palmaris et Plantaris with Evidence of Faulty Nervous Development.—Three cases of this dystrophy of the skin were studied. Two occurred in men, who showed interesting signs of nervous disease.

Both these men had trouble in the pyramidal tracts (extensor plantar reflexes with hypertonic muscles). One of them (fig. 6) had muscular fibrillation of the

Fig. 5.—Myelodysplasia with spina bifida, atrophic paralysis of calves and clubfoot.

face and degeneration and fibrosis of the calf muscles, and revealed a failure of sexual development. The other had an extensive paralytic kyphoscoliosis of the lower part of the spinal column. In this case, evidence was found that the trouble had its origin in an inherited faulty ectodermic structure. His mother, a maternal aunt, four brothers and sisters, three of his children and eight nephews and nieces had keratosis.

Ophthalmoplegia Familiaris Congenita.—This condition was seen in two children born of the same parents.[8]

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7. DeVries, E.: Spina Bifida Occulta and Myelodysplasia with Unilateral Clubfoot, Coming on in Adult Life, Am. J. M. Sc. **175**:365, 1928.

8. Li, T. M.: Congenital Total Bilateral Ophthalmoplegia, Am. J. Ophth. **6**:816, 1923.

Periodic Paralysis (Unexplained).—Two men were periodically paralyzed in exactly the manner described by Diller and Rosenbloom in 1914, and by Mensteudter and others later. A feeling of stiffness and "deadness" in the limbs always announced the oncoming attack. This was followed by weakness, which progressed in pronounced attacks to a complete paralysis resembling that of anterior poliomyelitis. The attacks passed, as a rule, within forty-eight hours after the onset. In neither case was there any record of other members of the family suffering in a similar way.

NEOPLASMS OF THE NERVOUS SYSTEM

The incidence rate of neoplasms of the nervous system as seen in the hospital was 950 *N*, 47 *G* and 61 *A*.[6]

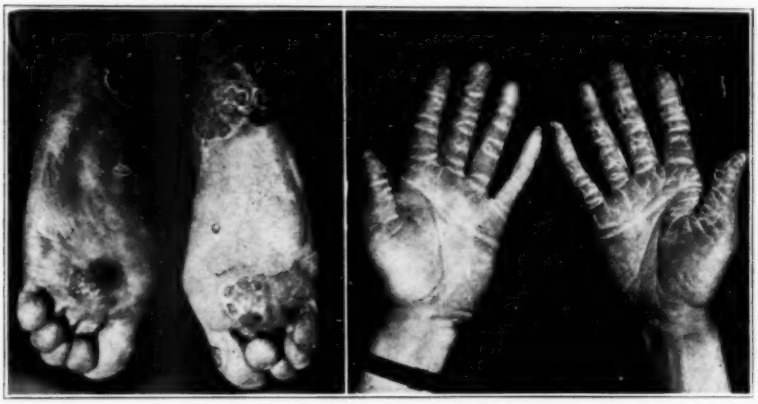

Fig. 6.—Keratosis palmaris et plantaris, with an underlying neurologic maldevelopment.

Glioma.—Of the four cases of glioma verified anatomically, three started in the retina; two of these had spread widely over the pia-arachnoid, and one had extended as far as the tip of the spinal cord. The brain and spinal cord were invaded superficially.[9] One glioma arose primarily in the pons varolii, but spread by metastasis to many parts of the brain and the brain-stem, involving the pia-arachnoid and the subjacent nerve tissues. An ependymoma, removed surgically from a patient who suffered with syringomyelia, was reported in 1927.[10] Other tumors, clinically considered as probably gliomas, but not verified by operation or autopsy, are not included in this report.

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9. I studied this case neuropathologically and my observations were partially described by Pi, H. T.: China M. J. **35**:449, 1921.

10. Woods, A. H.: The Removal of a Tumor from the Spinal Cord in Syringomyelia: Its Histology and Relationship with the Ependyma, Arch. Neurol. & Psychiat. **20**:1258 (Dec.) 1928.

Carcinoma.—Carcinomas involved the nervous organs in many cases as secondary growths. In one woman, following an abortion, a chorio-epithelioma had spread as far as the lumbosacral spinal roots.

Endothelioma.—This tumor was found in the spinal cord and brain in a number of Chinese patients. In one man, aged 35, a dural tumor, presenting the typical structure of the so-called "endothelioma," extended from the eyeball through the sphenoidal fissure back to the gasserian ganglion. It was removed in a three-stage operation, and the patient lived in relative comfort for a year after the removal.

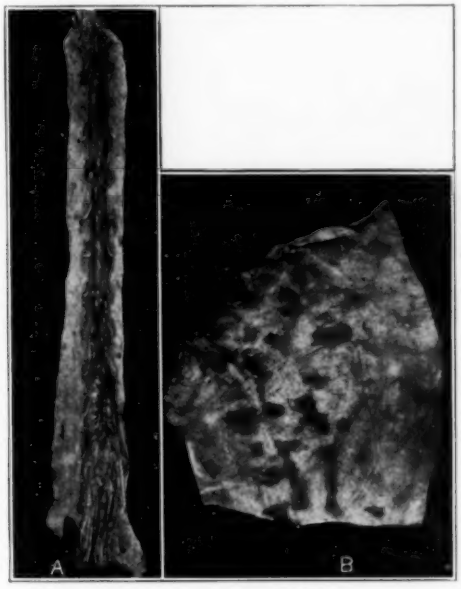

Fig. 7.—Neurofibromatosis. In *A*, tumors are seen on most of the spinal nerve roots and many peripheral nerves. In *B*, a piece of dura mater is shown (from the same patient) with tumor tufts, corresponding to which there were erosions in both the bone and the cerebral cortex.

Sarcoma.—Tumors of this type spread to and destroyed nerve structures in many cases. The origin, mode of growth and metastasis showed no peculiarity worth mentioning, as compared with such neoplasms in other races.

Neurofibroma.—The ordinary form of traumatic neuroma and the mesoblastic growths on the nerve sheaths are as common among the Chinese as elsewhere. Von Recklinghausen's multiple neurofibromatosis appeared in several patients in striking form. One Chinese woman physician had tumors on many peripheral nerves (fig. 7 *A*) and bilaterally on the spinal roots and on the roots of the second, fifth,

seventh, eighth, ninth and tenth cranial nerves. The dura in this case showed many nodules (fig. 7 *B*). The peculiar neoplastic growths in the scalp in two patients are shown in figures 8 and 9. In one of these (fig. 8), the skull was thin and had one defect 1 cm. by 3 cm. in

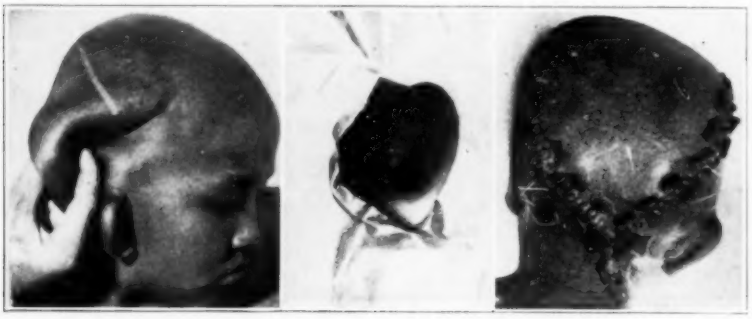

Fig. 8.—Neurofibromatosis with tumor in the scalp. Two stages of the operation for the removal of the redundant scalp are shown.

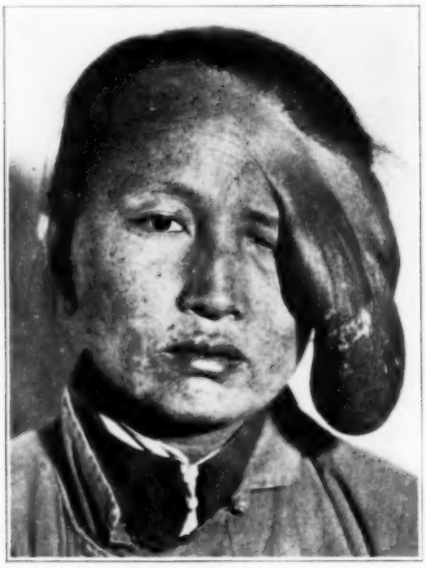

Fig. 9.—Neurofibromatosis with a pendant tumor of the scalp. This was successfully removed.

size; also, there were nevi and accumulations of pigment in the skin of various parts of the body. Microscopic examination of the scalp tissue showed the peculiar structure of von Recklinghausen's tumors.

Nevus.—This is a common form of tumor in the Chinese. An interesting case of nevus linearis is illustrated in figure 10.

HYDROCEPHALUS

The incidence rate of hospitalized cases of hydrocephalus was 200 *N* and 10 *G*.[6] Hydrocephalic heads are seen often among Chinese outside the hospital. In many cases, the condition is associated with mental impairment. As might be expected, many of the cases in the hospital were secondary to an existing meningitis, tumor or trauma. Of the long-standing cases, many were traced to meningitis of earlier date through persisting changes in the spinal fluid. The unusual dolichocephalic skull shown in figure 11 was that of a youth suffering, when admitted, from acute hydrocephalus, the cause of which was not discovered.

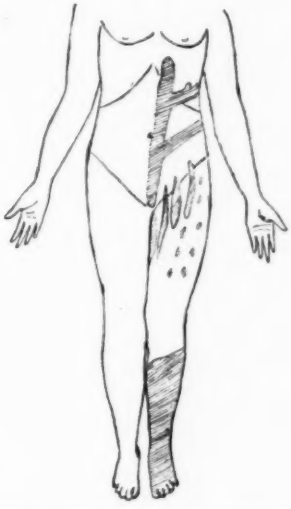

Fig. 10.—Ichthyosis linearis neuropathica. There is a striking conformity of pigmented nevi to dermatomes.

DEGENERATIONS AND SCLEROSES

Disseminated Sclerosis.—The incidence rate of cases of this disease in the hospital was 150 *N*,[6] 75 *G* and 186 *A*.[11] I have seen in China only two cases in which most of the classic symptoms of disseminated sclerosis were present.

A Cantonese villager had had, since his twenty-fourth year, numbness, weakness and awkwardness of the lower limbs. When I examined him five years after the onset, he showed clear evidence of disease of the pyramidal tracts, nystagmus, intention tremor, atrophy of the temporal halves of the optic disks and variable

11. Conway and Hill (Am. J. M. Sc. **174**:473, 1927) gave the incidence of this disease in the Philadelphia General Hospital as 700 per hundred thousand. Byrom Bramwell thought it would reach 1,200 for Northern England and Scotland.

paresthesias, but did not have any speech defect. A nearly identical group of symptoms was found in a youth in Peking, aged 19.

I did not find any other Chinese cases in the literature that could be identified clinically as belonging to this group. In six of the Peking cases tentatively diagnosed as disseminated sclerosis, anatomic proof has not yet been found. All these patients are still living.

A man, aged 39, had suffered a progressive and extreme spasticity of the lower limbs for sixteen months. He showed the usual signs of disease of the pyramidal tracts. He had had four peculiar seizures in which consciousness was dimmed and he went through queer performances, such as urinating in his shoe and attempting to draw on his blanket as trousers. These attacks lasted only a day at a time. There had been vertiginous attacks, but syllabic speech, nystagmus and intention tremor were not present. The spinal fluid was clear; its pressure was 150 mm., the cell count 112 (lymphocytes) and the protein content 70 mg. per hundred cubic centimeters. Signs of meningitis were not present, except for the

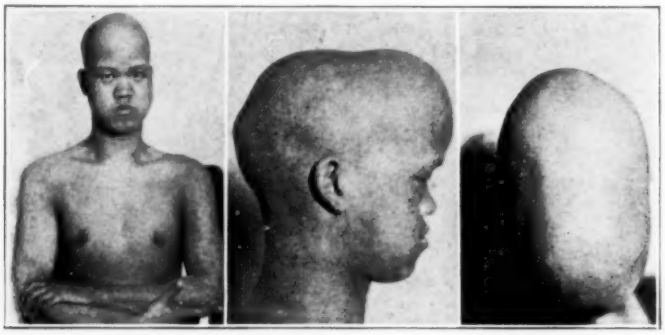

Fig. 11.—Hydrocephalus, with acute mania and increased intracranial pressure, in an intelligent merchant whose skull was peculiarly deformed. Evidence of earlier symptoms of pressure was lacking.

observations on the spinal fluid; Wassermann tests of the blood and the spinal fluid were constantly negative. The case may have been one of epidemic encephalitis without recognized onset, or of disseminated sclerosis caught in an acutely progressive stage.

Syringomyelia.—The incidence rate of cases of syringomyelia in the hospital was 350 *N*, 17.5 *G* and 20 *A*.[6] This disease was verified anatomically in two cases and clinically, with considerable certainty, in others.

In one patient there had been an abrupt tetraplegia following six months of progressive analgesia. The spinal fluid was xanthochromic, with a great increase in the number of cells and the protein content; x-ray evidence showed a subarachnoid block at the fifth cervical segment. Autopsy revealed a marked swelling of the lower cervical segments. In sections taken from this region, the microscope revealed masses of fatty granular cells and the detritus of the original cord sub-

stance, but not any evidence of inflammation. There were two fissures connected with the central canal, and these were surrounded with the peculiar homogeneous substance of Schlesinger. The walls of the smaller vessels were much thickened. Another case of syringomyelia, in which an ependymoma had formed at the mid-thoracic level, was referred to in the comment on glioma.

Amyotrophic Lateral Sclerosis.—The incidence rate of cases of this disease in the hospital was 100 *N* and 5 *G.*[6] Cases of neurosyphilis, of Pott's disease and of meningitis, in which the pyramidal tracts and the anterior horn cells had suffered damage, have been from time to time listed under this diagnosis in the outpatient service, but have later been properly classified. Among the cases remaining under this heading is one, anatomically unproved, which is interesting because of the peculiar muscular atrophy exhibited.

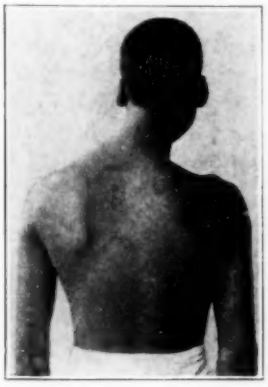

Fig. 12.—Peculiar muscular atrophy of the right side of the neck; beginning atrophy of the left side of the neck; possibly an amyotrophic lateral sclerosis.

A youth, aged 19, had noted a progressive melting away of the muscles of the right side of the neck (fig. 12), including the trapezius, sternocleidomastoid and deltoid muscles. These muscles showed fibrillary twitching. Sensory disturbances and evidences of local disease were not present. Also, the muscles of the left side of the neck were beginning to atrophy, and already showed fibrillary twitching. The pyramidal tracts had suffered, as evidenced by reversal of the plantar reflexes and the presence of ankle clonus.

Cases like that shown in figure 13 are clinically well established.

Primary Lateral Sclerosis.—This condition has been reported from other parts of China, but the cases tentatively thus classified at the Peking Union Medical College were not sufficiently verified.

Paralysis Agitans.—This disease was seen both among patients admitted to the hospital and, more often, as one walked along the streets. The parkinsonian syndrome after epidemic encephalitis was

one of the most common and most distressing clinical pictures seen in the wards and the outpatient service. Two patients who died with verified syphilis of the brain showed this syndrome, but as the cases did not come to autopsy, it was not possible to investigate the underlying lesion.

TOXIC, ENDOCRINE AND NUTRITIONAL DISEASES

Beriberi.—This disease, with an incidence rate in the hospital of 3,025 *N* and 151 *G*,[6] is much less often seen in Peking than in parts of China farther south. In Kuangtung province, in 1915, 50 per cent of the soldiers in one camp to which I had been called in consultation

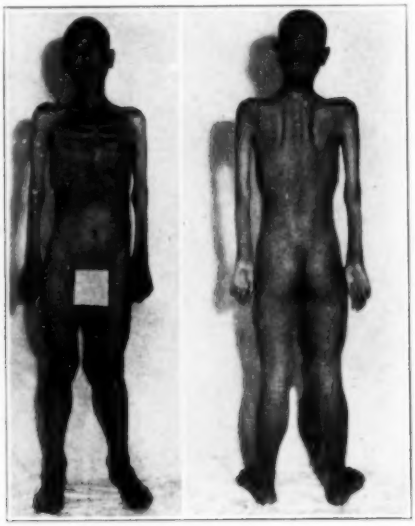

Fig. 13.—Amyotrophic lateral sclerosis, well established clinically.

were its victims. All patients with beriberi in Peking were residents of southern provinces who recently had come north, and who brought their dietary habits to their new home. Chinese of all classes are addicted to a peculiarly stereotyped diet. They will eat any quantity of so-called vitamin extracts, or even the unpalatable "rice-polishings," so long as these are called medicine, but they will not endure changes in their accustomed dietary.

Neuritis and Multiple Neuritis.—I have never seen any Chinese patients with alcoholic or lead neuritis, although Chinese in America are said to have developed alcoholic neuritis. Europeans living in China, who drink imported alcoholic beverages, often develop the disease. In the fermented and distilled drinks of the Chinese, the alcoholic content

is as high as in those of Europe or America. The favorite brand of the late Manchurian dictator tasted to me like absolute alcohol. The Chinese, moreover, drink copiously, though almost invariably with meals —a fact which may be related to their relative immunity to neuritis.

Opium and Morphine Habituation.—This condition brought many patients to the clinic for relief from the habit, or, more often, some of its troublesome sequels. The habit is widespread in China and, according to statements made by intelligent patients, many men and women use the drug for years without aggravated symptoms, and, withal, continue the ordinary routine of their lives. In most cases, the patients report that a parent, an acquaintance or a physician advised the drug because of some painful malady, such as pain in the joints. Without advice from others, it is a common resort for persons who suffer slight or intense pain, and for many who have real or imagined sorrows or whose lives lack excitement.

Hyperthyroidism.—This appears in the typical form. The average basal metabolic index in normal Chinese men and women is low. Dr. Chang, of the metabolic laboratory of the Peking Union Medical College, informed me that his averages are 7 per cent below those found in other countries.

One of the last patients examined by me in Peking was a young Chinese woman who showed marked tachycardia, an enlarged thyroid gland, fine tremors, nervous excitability and an unusually high metabolic index, but not any eye signs.

Hypothyroidism.—Cretinism and myxedema have been observed, and do not call for special comment.

Suprarenal Dysfunction.—Mills [12] found that many Chinese, and some Europeans and Americans, after several years of residence in China, suffer from a peculiar chain of symptoms that may be due to endocrine derangement. The gastric hydrochloric acid is reduced, the blood pressure and the basal metabolic index fall and the patients have abdominal pains, diarrhea and general signs of increased vagus tone. Mills found that the condition is corrected by the administration of epinephrine hydrochloride. He believed that it may be related to sprue.

Pituitary Disease.—Froehlich's syndrome has been observed by me in a number of Chinese patients, with and without signs of local disease. None of the patients with pituitary tumor was willing to undergo an operation. Some of them showed typical x-ray and endocrine signs, together with eye changes and the usual evidences of intracranial tumor.

12. Mills, C. A.: Functional Insufficiency of the Suprarenal Glands, Arch. Int. Med. **42**:390 (Sept.) 1928.

Tetany.—This is frequently seen among Chinese infants and young people. One orphanage, in particular, has supplied us with a considerable number of girl patients. I have studied two cases in which epilepsy, apparently idiopathic, was associated with tetany. One school girl with normal blood calcium and normal electrical reactions, during an epidemic of tetany among her school mates, showed a good hysterical imitation of the spasms of tetany. One of our staff members [13] showed that the fault in neuromuscular irritability in tetany is due to the diffusible form of serum calcium and is not caused by the nondiffusible calcium, both of which he found present.

Uremia.—Uremia is frequent among the Chinese, both during pregnancy and independent of it. The Chinese also frequently present the "toxemias of pregnancy." I have seen many of these patients show transitory cerebral paralyses, and many in whom high blood pressure was followed by permanent hemiplegia. Several cases studied neurologically were reported by Eastman.[14]

A case studied by me, but not included in his report, was that of a young primigravida in the fourth month, with uremic convulsions and with a systolic blood pressure of 195 mm. of mercury. She rapidly developed a complete paralysis of both the lower limbs and of the right upper limb. Although the signs of uremia disappeared after an immediate hysterotomy, the coma and the paralysis continued. An autopsy, performed four weeks after admission, did not show encephalitis, but disclosed a peculiar cortical softening. This consisted of multiple linear areas of cell destruction, which occupied chiefly the deeper levels of the cortex, but stopped neatly at the junction of the cortex and the white matter. These areas appeared to be at least a month old, and were thought to be the cause of the paralysis, since the motor areas corresponding to the paralyzed limbs were involved. A study of the vessels supplying the involved areas was made by Dr. De Vries, who found that vascular stoppage was not present. The possibility that a temporary or a permanent occlusion of the blood vessels was the cause of the softening had been suggested by the fact that many of the affected cortical areas occurred in pairs lying exactly opposite each other across fissures in such manner that they were supplied by identical vessels. Angiospasm with a transitory but destructive ischemia of the cortex must be thought of in such a case. Ricker [15] recently called attention anew to this possibility in toxic conditions.

Epilepsy.—This is one of the most frequently observed nervous diseases in Chinese patients (5,000 *N*, 250 *G*, 287 *A*[6]). In most of our cases, the onset had been during adolescence. Women were more often affected than men. The attacks, whether of grand or of petit mal type, showed the same features as are seen in Europe and America. Among

13. Liu, S. H.: The Partition of Serum Calcium Into Diffusible and Nondiffusible Portions, Chinese J. Physiol. **1**:331, 1927.

14. Eastman, N. J.: Puerperal Hemiplegia, Am. J. Obst. & Gynec. **15**:758, 1928.

15. Ricker, G.: Sklerose und Hypertonie der innervierter Arterien, Berlin, Julius Springer, 1927.

the curious psychic auras in Chinese epileptic patients was that of a boy who always knew that an attack impended by a vivid feeling that a stranger had approached from behind and was about to make a disagreeable remark. In a number of syphilitic adults, who had fits indistinguishable from those of epilepsy but without the history of epilepsy prior to infection, the attacks ceased after antisyphilitic treatment.

INFECTIOUS DISEASES OF THE NERVOUS SYSTEM

Sydenham's Chorea.—The incidence rate of rheumatic fever in this hospital was 38 per hundred thousand during the period included in this report, i.e., a little more than five times the incidence rate of chorea (150 *N*, 7.5 *G* and 150 *A*).[6] One of the patients with chorea was a woman, two were men and three were little girls. All had suffered recently with septic foci, such as tonsillitis or pyogenic abscesses. Three had signs of endocarditis.

Pyogenic Infection.—Pyogenic infection is extremely common in China, and has been particularly so during the past decade of military operations. The medical attention received by wounded soldiers and civilians was, as a rule, worse than useless. After one five-day battle near Peking, a wounded soldier reported to us that the wounded were sorted and placed in two fields, one of which contained those who were to be removed later, if convenient; and the other, those who were not worth attention. As a result, wounds of the head, spine and nerves were practically always in bad condition from sepsis when the physicians of the hospital staff saw them.

Meningitis.—Meningitis from pyogenic organisms, introduced through wounds or through the vessels, was often seen. Other forms of meningitis were influenzal (50 *N*), pneumococcic (75 *N*), syphilitic (listed subsequently), tuberculous (1,050 *N*) and meningococcic (1,025 *N*).

Encephalitis.—Various forms of encephalitis, including pyogenic cases, were frequently seen in Peking. In the cases of typhus fever, covered by this report, the changes in the brain were among the most striking postmortem observations. They lead one to suspect that the encephalitis in that disease is an important factor in the causation of the accompanying delirium and the subsequent psychic exhaustion. It is remarkable that permanent mental and paralytic sequels are, as a rule, absent after convalescence. In only one of the typhus patients were there significant motor symptoms. This man had ankle clonus and a reversed plantar reflex up to the time of his discharge from the hospital.

Epidemic Encephalitis.—The incidence rate of this disease in the field covered by this report was 3,850 *N* and 192 *G*.[6] It was reported

in various parts of China about the time of the return from Europe of the army of Chinese laborers associated with the forces of the Allies. At first, and up to 1922, the symptoms at onset included paralyses of the cranial nerves, myoclonus and lethargy more frequently than they have since that period. Most sufferers remember the febrile onset, but many do not. Myoclonus has been rare in the hospitalized cases of the past five years. In two Chinese boys, the somnolent periods came on several times a day, so suddenly that the patients would scurry to their beds like rabbits to their warrens and be sound asleep within a minute. Freakish changes in conduct were seen, such as those observed in one man who from time to time marched down the ward asking inane questions of the patients whom he passed. One English boy, aged 16, was found at times by the nurses lying prone across the bed with his head hanging to the floor, eating his meal from a plate which he had placed beneath the bed. Among the cranial nerve palsies, a paralysis of visual accommodation and of the pupillary movements associated therewith was the most common. Six patients had the spasmodic upward movements of the eyeballs that have been reported by observers in other places. In three of these patients, the convulsive movements involved those muscles of the neck and back that are concerned in looking upward; the movements in one patient were almost as severe as those of epilepsy.

Parkinsonism is lamentably frequent. Some of the patients resembled persons imprisoned in coats of mail, afferent impulses and psychic functions being unimpaired, but all higher coordinated movements of speech, facial expression and gesticulation, walking, eating and balancing were seriously crippled.

Encephalomyelitis.—A Russian lady and later, in less degree, three of her Chinese nurses, after slight prodromal fever and symptoms in the upper part of the respiratory tract, became paralyzed progressively from the oculomotor apparatus downward through the lower cranial nerves, and at length in the lower limbs. Chewing and swallowing in one of them were abolished, so that tube feeding became necessary. The necks were flaccid. All recovered completely, the order of recovery being step by step from the lower spinal cord upward. The symptoms involving the cranial nerves were much severer than those involving the spinal centers.[16]

In the Union Medical College Hospital, a number of cases of acute fulminating, often rapidly fatal encephalomyelitis have been clinically and histologically studied. The disease affected both the Chinese and the foreign patients. Some of the patients were infants. One was a

16. Woods, A. H.: Four Cases of Polio-Encephalitis with Apparent Contagion, China M. J. **41**:111, 1927.

woman past middle age. The unit focal lesion was indistinguishable under the microscope from that of acute anterior poliomyelitis, but not in one case was there, even for a brief period, the lower neuron paralyses of that disease. The lesions of the brain were more conspicuous than in any case of poliomeylitis in my experience.[17]

In all the cases of encephalomyelitis cited, the factor of contagiousness was suggested by the propinquity of the patients at the time of onset. This feature was still more conspicuous in a group of fourteen patients studied by me in Shantung province. In these cases, however, the evidence was against an inflammatory basis and in favor of a purely degenerative process, possibly toxic. The symptoms in each patient had been a suddenly developing loss of muscle tone followed in some by frequent spasms like those of "torsion spasm." An autopsy in the one case in which examination was made showed gross softening in each globus pallidus and in the substantia nigra, and, microscopically, widespread death of ganglion cells and secondary neuroglial changes.[18]

Acute Anterior Poliomyelitis.—The incidence rate of this disease in the hospital was 950 *N* and 47 *G*.[6] The disease is a frequent malady in all parts of China from which I have been able to get reports. It is peculiar, however, that in all the cases included in this report, except one, the disease appears to have been sporadic. The existence of an epidemic in China has not been reported, and our examinations into the neighborhoods of patients recently attacked has not shown any coexistent epidemic. The father of a patient from Shantung province stated that another child in his neighborhood had been paralyzed simultaneously with his child. Two of my American patients, taken ill at one time, reported that a Chinese child, the daughter of their servant, who lived in an outhouse adjoining their residence, had been ill at the same time that they were attacked and with the same symptoms; but paralysis had not followed. A case of chronic anterior poliomyelitis is shown in figure 14.

Posterior Poliomyelitis.—Acute and chronic posterior poliomyelitis have appeared frequently, as herpes zoster and in cases of tuberculosis, syphilis and other forms of disease affecting the dorsal ganglions. It was found in a case of kala-azar, in which the membranes and spinal cord were also involved.

Rabies.—This condition is encountered in China in the same form and with the same features as elsewhere. Immunization is practiced in

17. The two earliest of these cases, affecting occidentals, were reported by Meleney, H. E.: Fulminating Encephalomyelitis, Arch. Neurol. & Psychiat. **10:** 411 (Oct.) 1923.

18. Woods, A. H., and Pendleton, L.: Fourteen Simultaneous Cases of Acute Degenerative Striatal Disease, Arch. Neurol. & Psychiat. **13:**549 (May) 1925.

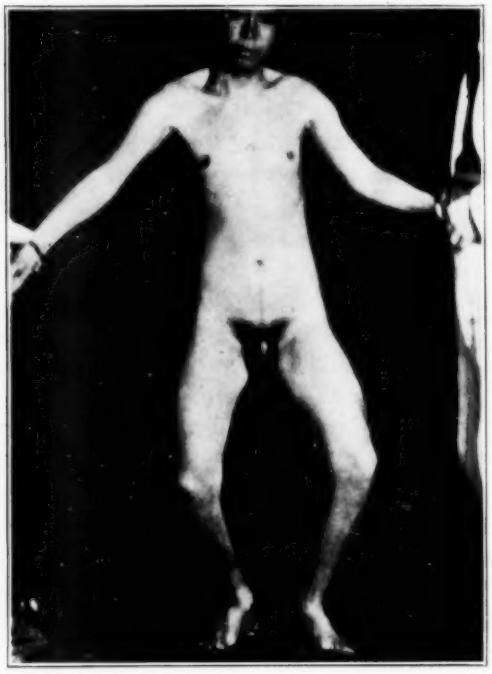

Fig. 14.—Chronic progressive anterior poliomyelitis in a man 38 years old. Onset occurred at the twenty-second year and development was gradual.

Fig. 15.—Syphilitic paralysis of both facial nerves, of thirteen years' standing.

the Peking Union Medical College and several other hospitals in Peking and the port cities of China.

Tetanus—The incidence rate of this disease was 625 *N*, 31 *G* and 29 *A*.[6] Tetanus bacilli were found by Ten Broeck and Bauer[19] in the feces of one third of the patients in the general wards of the Peking Union Medical College Hospital. In their laboratory experiments on animals they showed that some degree of immunity was established by feeding the animals tetanus bacilli, but only for the particular types of bacilli thus introduced. Yet, tolerance for the toxin itself, even of the types ingested, was not produced. Open wounds on the limbs are common in Chinese laborers and farmers, and tetanus organisms are available everywhere. It seems surprising, therefore, that active tetanus is not even more prevalent than it actually is. In the opinion of Ten Broeck and Bauer, the explanation is that the tetanus organisms constantly introduced into the intestine with contaminated food enter the mucosa through small abrasions, and thus keep up a process of graduated immunization.

Type of Neurosyphilis	Per Cent of All Cases
Meningitis	4
Spinal cord, the chief site	18
Brain, the chief site	18
Brain and cord (exclusive of the foregoing conditions)	42
Tabes dorsalis	13
Dementia paralytica	4

Three of the patients with tetanus were infected through wounds of the face, and two of them showed paralysis of the corresponding facial nerves. The third patient was paralyzed in the motor trigeminal nerve on the same side as the wound.

Tuberculosis.—This is one of the most frequent and devastating diseases of China. It invades the nervous organs (1,925 *N* and 96 *G*)[6] in the form of Pott's disease of the vertebrae, meningitis and solitary or multiple tuberculomas.

Syphilis of the Nervous System.—Syphilis was the most frequent organic nervous diseases seen by me in Chinese patients (22,825 *N*, 1,141 *G*).[6] Syphilis in Chinese subjects was described by medical writers as far back as the early part of the sixteenth century, when European merchants first visited South China and established trading colonies. References to syphilis in Chinese literature previous to that period are too vague and the terms used too inaccurate to prove that syphilis existed in China before that time. The types of neurosyphilis in our patients were as shown in the accompanying tabulation. Lesions

19. Ten Broeck and Bauer: J. Exper. Med. **48**:361, 1926; ibid **37**:479, 1923; ibid. **36**:261, 1922.

of the cranial nerve are common. A case of double facial paralysis is shown in figure 15.

Abrupt softening of the spinal cord (fulminating "transverse myelitis") from thrombosis of spinal vessels was observed. In some of these cases, the patients had not suffered any previous inconvenience. In some cases, there were found, post mortem, scattered foci of meningomyelitis with thrombosed veins leading from the pia mater into the cord substance, and consequent softening of the marrow.[20]

My experience and that of others in North China and my previous observations in South China lead me to a conclusion the opposite of that reached by many medical observers and published by them, namely, that neurosyphilis is relatively rare among the Chinese and that tabes dorsalis and dementia paralytica are almost nonexistent. Two recent writers supposed that malaria had protected the Chinese from neurosyphilis. This theory is contradicted by my experience in Kuangtung province, where malaria was rife and neurosyphilis and parasyphilis were frequent.

An investigation by competent neurologists and syphilographers, working together, would probably show that all forms of nervous syphilis are prevalent in most parts of China. It would, however, be a contribution of great value if it could be shown that neurosyphilis is, relatively to general syphilis, less frequent in those parts of China distant from trade routes and therefore exempt from strains of ("neurotropic") spirochete imported from foreign countries, and, furthermore, where the methods of treatment prevalent in Europe and America are not used.

The apparent infrequency of this diagnosis in the records of many physicians in China may be due in part to the fact that their time and chief interest were necessarily devoted to other matters, so that they were not in a position to make adequate serologic investigations, particularly Wassermann tests and studies of the spinal fluid. Many patients in whom careful physicians had found, for instance, the pupillary reactions normal, and in whom I, on the other hand, found the light reaction totally absent, had been examined without precautions to insure that accommodative movement was excluded while the light reaction was being tested. For this reason, the Argyll Robertson pupil is easily overlooked when the pupils are examined in a dark room.

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20. Chung, M. F.: A Study of Thirty-Four Cases of Rapidly Developing Paraplegia, Arch. Dermat. & Syph. **14**:111 (Aug.) 1926; Thrombosis of the Spinal Vessels in Sudden Syphilitic Paraplegia, Arch. Neurol. & Psychiat. **16**:761 (Dec.) 1926.

In my series of tabetic patients, of whom thorough serologic, as well as symptomatic, studies were made, the following features appeared:[21]

Average age of tabetic patients on admission	48½ years
Average age of tabetic patients when first symptoms were noted	40 years
Earliest age at which first symptoms appeared	22 years
Latest age at which first symptoms appeared	60 years
Average interval between the chancre and the earliest symptom	9 years
Lancinating pains present in	55.6%
Gastric crises present in	3.3%
Ataxia in gait, station or finger-to-nose test	70 %
Deficient tendon reflexes	92 %
Ankle and tendon reflexes, both sides	86.6%
Ankle and tendon reflexes, one side	3.3%
(Achilles reflexes were absent more often than the patellar)	
Pupillary abnormalities:	
Inequality	51.6%
Irregular outline	31.6%
Argyll Robertson, absolute	43.3%
Argyll Robertson, partial	33.3%
Paresis of external eye muscles	21.0%
Optic atrophy	23.3%
Arthropathies	10 %
Serology:	
Wassermann test of the blood positive	81.6%
Wassermann test of the spinal fluid positive	83.0%
Wassermann test of the blood and spinal fluid both positive	70 %
Spinal fluid cell count of 9 or more	80 %
Spinal fluid protein content of 35 mg. or more per 100 cc	75 %

Leprosy.—Leprosy is much less frequent in Peking (525 *N* and 26 *G*)[6] than in the provinces farther south. The dread of this disease is not as great among Chinese as among occidentals. In the leper colony of Canton, noninfected persons lived not only in the colony, but even in the same houses with lepers, their peculiar preference being due sometimes to family ties, but often to economy or to mere convenience. It is a widespread belief among them that leprosy is transmitted only in sexual coitus.

DISEASES OF THE BLOOD AND BLOOD VESSELS

Leukemia, Hodgkin's disease and the purpuric diseases were observed in Chinese patients. These conditions show the same tendency to produce hemorrhages in the nervous system as is seen elsewhere. Pernicious anemia in a Chinese patient has not been described; the secondary anemias in the Chinese are at times followed by combined funicular scleroses.

Cerebral Thrombosis and Hemorrhage.—These are among the common accidents that bring patients to the various clinics in China (5,625 *N* and 286 *G*).[6] In younger patients, syphilis is the usual basis, the next in order being disease of the kidneys.

Arteriosclerosis of the Nervous System.—The incidence rate of cases of arteriosclerosis of the nervous system in this survey was 2,600 *N* and 130 *G*.[6] It showed itself through the usual signs: high blood pressure, rupture of vessels and ischemia of the brain or spinal cord with resulting paralysis, claudication, dementia or other cortical

21. Wei, Y. L.: Tabes Dorsalis Among the Chinese, China M. J. **41**:698, 1927.

functional loss. Old age in the Chinese is manifested, as has been true in the human race from the time of the earliest records in literature, by canities, atrophy and wrinkling of the skin, mental enfeeblement and loss of bodily vigor. Various writers have referred to the infrequency of arteriosclerosis in this race. I am not in position to supply accurate information as to its relative frequency, but experience gives both clinical and anatomic evidence that it exists and that in Chinese affected it cripples the nervous system relatively frequently.

ANIMAL PARASITES

Amebic Abscess of the Liver.—In a recent case this condition gave the usual signs and symptoms; in addition, there were evidences of a transverse lesion of the spinal cord in the lower thoracic region with an enormous increase in the protein content of the spinal fluid, yet without an increase in the cell count. Extension of the abscess to the epidural region seemed to me the probable explanation. Ventral operation revealed a multilocular amebic abscess with extensions far back toward the vertebrae. Drainage was followed by subsidence of the symptoms of involvement of the spinal cord.

Cysticercus Cellulosae.—Invasion of the cerebral hemispheres by this organism was discovered at the surgical table in a Chinese medical student who had suffered for several months with epileptiform convulsions. Six larval cysts were found within the cortical area uncovered in the operation. One other case was reported by a western trained physician from the same district in Shantung province from which the former patient had come.

Malaria.—This disease is one of the major scourges of China. In many provinces it is the cause of enormous economic loss annually. The malignant form with cerebral symptoms was not seen among the cases, numbering several thousands, seen by me in the region of Canton; but, according to the report of H. E. Meleney, it is common in other regions, such as Hongkong, Huchow, Chekiang, Wuchow and Suchow. In my experience, malarial neuritis was uncommon among Chinese patients, though I saw interesting cases in Americans who were infected in China. A Chinese man in North China showed a peculiar cerebellar disturbance, which at first suggested multiple sclerosis.[22]

FUNCTIONAL NERVOUS DISEASES IN CHINESE PATIENTS

The incidence rate of cases of functional nervous diseases in the Peking Union Medical College Hospital was found to be 23,550 per hundred thousand.

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22. DeVries, E.: Nervous Complications in Pernicious Malaria, China M. J. **41**:503 (June) 1927.

Headache, for which no explanation could be discovered in the head cavities and in the various organs, was one of the most frequent discomforts that brought Chinese to the neurologic clinic, the cases occurring at the rate of 2,250 *N* and 112 *G*.[6] Migraine, occurring at the rate of 275 *N*, appeared in the typical form, with attendant symptoms in the eyes and the alimentary system. The existence of the trouble in the parents was relatively often acknowledged.

Other neurotic disturbances for which a basis could not be found in the nervous organs or in the patients' emotional condition were: unexplained paresthesias (acroparesthesia in twelve patients); gastric secretory neurosis; occupational cramp; stammering and lisping; tics of various organized movements, particularly those of the face, neck and shoulder; spasms of limited muscle groups, usually those of the face; angioneurotic edema and hyperhidrosis. Disturbances in the menopause were common, and consisted most often of headache, flushing of the skin surface, chilly feelings, dizziness, nausea and excessive fatigue.

PSYCHONEUROSES

In this group (4,675 *N* and 233 *G*)[6] are listed those neuroses in which the basis was psychic, a failure of the person because of his emotional constitution suitably to adapt himself to his situation.

The sexual life of the Chinese is different from ours in its superficial exhibitions, but obviously has under it the same deep instinctive and emotional forces. They are driven by strong cravings, and these are inhibited by equally vigorous regulative and protective devices on both the instinctive and the intellectual levels. Hence, there are repressions, out of which conflicts arise, causing stormy emotional disturbances. They are spared, however, much of the mysteriousness and the sense of intrinsic wrongness, the feeling that the act of coitus is in itself unclean, that complicate the sexual struggles of Jewish and Christian peoples. With them, as with the Greeks, the gods are not greatly worried by human amours. At any rate, sexual conflicts have brought fewer Chinese than foreign patients to the clinic, and, it should be noted, the incidence of emotional trouble springing from sexual cravings was not excessive among the American and European patients who were treated in my department in Peking.

As to intensity of sexual feeling, the Chinese exhibit strong excitement under appropriate stimulation, and their capacity for sustained indulgence appears to be remarkable, if the confessions (or boasts) of some of them are to be believed. In the case of male Chinese, the restraints from within and from without seem to be feebler than is the case with males of western lands. They go to prostitutes as they go to restaurants, and the practice is as frankly accepted by

society. Masturbation and even homosexual connections are not regarded with the same loathing that they arouse in westerners. The craving of women for extramarital indulgence is opposed, if not by theological notions or ideas of intrinsic uncleanness in sexual acts, at least by the strong feeling, on the part of the men, of property rights over their women. A virgin daughter will bring better marriage "arrangements" than a deflowered girl. In women the fear of pregnancy is, of course, always an additional restraint.

Jealousy is as fierce in the Chinese as elsewhere when coveted love strays to superior attractions. Herein is one of the greatest of the drawbacks to polygamy, and Chinese philosophy has not been able during many millenniums in which it has flourished to remove this fly from the ointment. On the other hand, true modesty also flourishes there, and it is doubtless there, as in other countries, an instinctive biologic contrivance, tending to limit indulgence to suitably mated couples, so as to secure finer offspring. For that reason, it becomes the groundwork of subtler conflicts when its control is disturbed by the pressure of passion. One also sees in China prudery, the pathologic counterpart of modesty, in those who fail to attract, and therein find virtuous explanation of the failure.

Moral conflicts induce pathologic emotional conditions in the Chinese when appetites and higher sensibilities clash. Their expression for conscience is "liang hsin" (equitable heart), and that organ seemed to me to influence them more than it does any other Asiatics that I have known. Conscience makes cowards of Chinese who plan evil, and remorse after the act gnaws at their vitals until relief is found in confession and restitution, or compensation is secured through some psychoneurotic diversion. In quality, their moral intuitions are fundamentally the same as those of occidentals. It is significant of the solidarity of the human race that for nearly every folk-saying, fable, epigram and moral maxim known to me in Greek, Latin, Hebrew, Anglo-Saxon and English, the Chinese have a worthy duplicate based on the same moral principle. Incidentally, their wit and humor are called forth by the same elements in incongruous situations that evoke our own.

In spite of his apparent external calm, the Chinese suffers stormy internal conflicts. He is sensitive to public opinion. When he has "lost face," if some resolution of the situation that caused his predicament is not found, ordinarily he will break down.

One young college man was the business manager of a Chinese charitable organization. At the close of the year, two of his subordinates left him for a vacation, thereby disobeying his explicit orders. As a result, his accounts could not be rendered to his superior in time, and a cash deficit could not be explained.

He did the only thing that seemed to him to offer relief from unbearable tension—he cut his throat, not fatally, yet dramatically enough to induce all concerned to dislike the offending subordinates and to applaud his serious-mindedness and integrity.

Intolerable situations in domestic life frequently arise in Chinese families, and these become the "sloughs of despond" out of which the readiest way often is found through psychoneurotic devices.

A deserted sister-in-law was cruelly overworked and imposed on. She came to the hospital to ask relief from gastric distress. On her way out, she suddenly fell on the floor palsied in all limbs. A strong young automobile mechanic was harried by his mother and forced by her for private reasons of her own to move his own family and to live with his older brother's family. He grew depressed, lost weight, developed dyspepsia, could not sleep, and finally became so weak that he could not work.[22] A childless, middle-aged "principal wife" was the happy and respected queen of her home. Her sexual attractiveness waned and her husband introduced a pretty concubine, who had a way with men and soon dominated the household. Satisfaction could not be found by the older woman in society, books or religion, and after a few years a chain of secretory troubles, indigestion, headaches and general feebleness brought her to the hospital.

As the field of interest of the Chinese women is limited, it is difficult to guide them into new activities in which compensatory satisfactions for major cravings can be found.

Fear as to future security, dread of disease, particularly of syphilis, and such calamities as loss of fortune or death of relatives and friends have been the basis of psychoneuroses in some of the patients. Inferiority complexes are among the commonest emotional derangements that drive them into these abnormal reactions.

Hysteria.—The incidence rate of cases of hysteria in the Peking Union Medical College Hospital was 3,325 *N.*[6]

A woman invited by a male relative to a family feast suspected the host of improper designs on her. She could not refuse the summons to the dinner. The first mouthful that she ate nauseated her, and she was sure she was being poisoned. She became anesthetic to touch, pin-prick and temperature changes over the entire surface of her skin, although vision, taste and hearing were unimpaired, and she was aware of changes in the temperature of the atmosphere so that she would return to the house for extra clothing if caught out in the cold. If food or drink was too hot or too cold, she noted it at once. This condition continued for more than a year.

I have seen a case of major hysteria in a Chinese coolie woman who believed that a chicken had "taken possession" of her. She quieted down at once when I placed my hand on her forehead and told her not to be afraid. A considerable literature on "demoniacal possession" in China has followed Nevius' book[23] on the subject. According to

22. Woods, A. H.: The Removal of the Cause, etc., China M. J. **42**:366, 1928.
23. Nevius, J. L., DD.: Demon Possession, London, Redway, 1897.

White,[24] the number of cases in a single province had reached several thousands at the time of his report. My own experience with this phenomenon is small, but from the few cases I have observed and from the descriptions given by these writers and others, I do not see any essential difference between them and ordinary hysterical seizures, such as would appear in any one when the effective suggestion was the conviction that a demon had entered him.

In all the cases described in the literature, the following conditions were present: The patients had previously believed in the existence of demons and in the ability of demons to enter and control human beings. The patients performed during their seizures according to the ideas that had been previously held of demoniacal behavior. They did what they supposed a devil would force them to do when once he had entered them. They went through frenzies, ecstasies, angers or violent attacks on onlookers, or lay as if unconscious. They uttered curses and prophesies. Often they chanted, usually malignant threats against former enemies. Usually, the motives were obvious. The victims were girls who had been seduced and disgraced, wives who had been badly treated, or persons who had substantial reasons for desiring revenge; and the demon always acted in a way to cause the greatest possible uneasiness and discomfort to the alleged aggressors. In brief, the performances gave respite and satisfaction to the patients. Nearly all the victims were women. The exorcisms were always accompanied by the impressive and dramatic presentation to the victims' minds that a deity superior to the demon which was then present had issued orders that the demon must depart.

An example of hysteria in a male Chinese was the case of a cook whom I once approached and who supposed I had a knife in my hand and was about to operate on him for an abscess with which he suffered. He fell to the floor, writhing, screaming and frothing at the mouth. Chinese military patients in the hospital developed paralyses or spasms in muscles entirely unrelated to the regions in which they were wounded.

Individual and mob hysteria have characterized many of the scenes in China since the beginning, in 1925, of the present phase of their national evolution. A party of zealous students in Peking approached the home of the national president to present a recommendation. The president's bodyguard fired on them and killed some, wounding many. Among the crowd that came to the hospital, I saw one student, who was unhurt, propelling himself over the hospital floor in a wheel-chair, with his mouth wide open and his eyes rolling, emitting sounds like the whining of an animal—an instance of war hysteria (shell shock).

Neurasthenia.—The incidence rate of cases of neurasthenia in this group was 13,075 *N* and 653 *G*.[6] This diagnosis was made only when a patient manifested a habitual and constitutional defect of energy,

24. White, H. W., DD.: Demonism Verified and Analyzed, Richmond, Presbyterian Board of Publication, 1922.

over-fatigability and hypersensitiveness to proprioceptive stimuli. The literary and student class were the chief sources of these derelicts. In a different class were the patients with acquired "sexual neurasthenia," due to depletion by masturbation or sexual coitus.

Sexual Perversion.—This condition is seen frequently in China, more often in schools and charitable institutions than in hospitals. The heads of schools and colleges have reported to me that homosexuality in both men and women is a frequent cause of embarrassment to them. It is said to be frequent among the coolies who go in crowds to distant regions as contract laborers, and who are thus separated from their wives.

A peculiar case in my own experience was the predicament of a chaste and learned college professor, who sought counsel because of the amorous desires of his male secretary, a married youth. The secretary assured the professor, and had well nigh convinced him, that yielding just once would be a charitable act, and would double the secretary's efficiency. The young wife of a merchant told me that, in her circle of society, the women practiced various objectionable methods of securing sexual orgasms for their husbands, partly to prevent conception, and often simply as a temporary expedient during the woman's menstrual period. In the latter case, it seemed to the wives preferable to the proposed alternative of admitting a secondary wife or concubine as a substitute during those recurring periods.

Among our Chinese patients were found sufferers with the ordinary forms of obsession, morbid compulsions, anxiety neuroses and the "effort syndrome." Under the classification of personality inadequacy was grouped a large number of patients who did not show any actual neurosis, psychosis or mental defect, who, on the contrary, usually showed considerable interest in normal activities and were moved by good intentions, but who were unable to meet the simple and obvious conditions of life by which they were surrounded—who could not "get on," could not earn a living. Most of these were from the student and leisured classes, but some were laborers.

MENTAL DISEASES

The Peking Union Medical College does not admit psychotic patients into its wards, but many were brought into the outpatient service for examination and advice. Some of these were followed for long periods by visits to their homes or to the police "prison for the insane." It is customary in such places to restrain excited patients by ropes or chains, or by locking them in closets or rooms. One well-to-do merchant whom I was called to see was living in an iron cage built into a corner of his room. He had lived in it for six years, and even during the lucid periods between his manic-depressive attacks, his family feared to release him. It has been reported to me that in some regions the

police occasionally break the leg bones of excited patients in order to keep them in one place. Depressed patients are, as a rule, merely left to their own devices. Their inability to care for themselves soon eliminates them from the rigorous competition, which is sufficiently taxing on even the sanest members of Chinese society.

Mental and Moral Defects.—Mental defectives of all grades were frequently brought to the hospital; some of them showed evidence of gross lesions of the brain. Postmortem examination, in the cases in which it was permitted, showed the usual evidences of birth trauma, hemorrhage, encephalitis or meningitis. Hydrocephalus associated with idiocy was often observed. Patients with hypothyroidism did not show features that would mark the condition in the Chinese as different from that in other races. My associates in China and I are not yet able to throw any light on the "mongolian" form of idiocy, because of a lack of the opportunity for a detailed study of this disease. Of course, the facial appearance of all Chinese defectives is more or less "mongolian," and the other physical and mental characteristics of the so-called mongolian idiot are not sufficiently specific to make distinction possible.

A number of Chinese patients were classified as constitutional psychopaths, who, under strains, emotional or physical, periodically broke down and became confused, excited or depressed, although under easy conditions of life they were apparently normal.

Psychoses.—Typical manic-depressive forms appeared in 5.4 per cent, and dementia praecox in 35 per cent of all the mental cases studied (exclusive of senile and paralytic dementias). A number of cases of simple depression or simple mania occurred, which were observed for long periods afterward, but without seeing any reappearance of the psychosis. Senile dementia conformed to the same types seen elsewhere and does not call for special comment.

THE NEUROLOGIC ASPECTS OF INTERMITTENT CLAUDICATION *

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My purpose is to review the condition commonly spoken of as intermittent claudication and to point out features which are of particular neurologic interest. The term intermittent claudication, as Buerger [1] said, should be rejected as descriptive of a disease and should be restricted to a combination of associated symptoms observable in a number of different pathologic processes.

Intermittent claudication may be a symptom of any form of arterial disease, though usually it is due either to arteritis obliterans or to arteriosclerosis of all or a portion of a peripheral tree. Buerger quoted Bing [2] as finding it impossible to differentiate between the intermittent claudication of endarteritis obliterans and that of arteriosclerosis. However, there is a contrast which is usually maintained. With arteritis obliterans, gross trophic changes, frequently gangrene, occur. In the conditions due to arteriosclerosis gangrene is extremely rare. My experience has been with intermittent claudication as a symptom of arteriosclerosis and it is with this type of condition only that this paper will deal.

My observations are based on a study of ten patients encountered during the past few years in a clinic and in private practice. Only two of the ten were women—a fact which emphasizes the well known greater occurrence of the condition in men. All the patients had typical intermittent symptoms in the legs. In a few instances, the presence of symptoms only during walking directed special attention to the patient. In the majority of patients, however, routine palpation of the arteries led to discovery of the condition, and it was possible to obtain the typical history afterward.

Intermittent claudication in man was first described, in 1858, by Charcot.[3] At that time, he discovered that a condition occurred in man comparable to "springhalt" in horses, which had been written of by

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* From the Neurological Department of the Bellevue Hospital.

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1. Buerger, Leo: The Circulatory Disturbances of the Extremities Including Gangrene, Vasomotor and Trophic Disorders, Philadelphia, W. B. Saunders Company, 1924.

2. Bing, R.: Beihefte z. med. Klin. **3**:111, 1907.

3. Charcot: Sur la claudication intermittente, Compt. rend. Soc. de biol. **2**: 225, 1858.

several veterinarians during the previous twenty years. Numerous papers on the subject appeared in the French literature following the article by Charcot. The important study of the condition by Erb appeared in 1898. Shortly afterward, numerous reports were made by American authors, including Dana [4] and Burr and Camp; [5] a decade later came the articles by J. R. Hunt,[6] who in his second paper, pointed out that the syndrome has a number of clinical types "which receive their special distinguishing characteristics from that portion of the arterial system which is involved—the tibial, brachial, coronary, mesenteric, cerebral and spinal arteries." Hunt extended this list to include the lumbar arteries and described ischemic lumbago, a new clinical entity occasioned by that localization. Oppenheim [7] had called attention to the arm type, Determann [8] to localization in the tongue, Ortner [9] to the mesenteric type, Rosenfeld [10] to involvement of the central artery of the retina and Dejerine [11] to spinal localization.

Dejerine's paper (1906) concerning the spinal types is of most interest here, for he described a syndrome due to intermittent claudication of the spinal arteries; it consisted of paresthesias and pain and weakness of the legs, induced by walking, and accompanied by a transitory increase of the deep reflexes and clonus and even a positive Babinski reflex. Rest relieved the subjective symptoms and also altered the objective signs. Dejerine stressed the fact that, as regards the pain and weakness produced at the end of a certain period by walking, intermittent claudication of peripheral origin and that of spinal origin are identical. The differential diagnosis between the two conditions lies in the fact that pulsations in the peripheral arteries of the legs are intact in the spinal type. Dejerine added as a corollary of this that there is a complete absence of vasomotor disturbances. On the other hand, an absence of arterial pulsations and the "presence of vasomotor phenomena are characteristic of intermittent claudication of peripheral origin." In Dejerine's words, "In intermittent claudication of the spinal cord, events arise as

4. Dana, C. L.: Intermittent Claudication (Intermittent Limping) Due to Obliterating Arteritis, M. Rec. **61**:290 (Feb. 22) 1902.

5. Burr, C. W., and Camp, C. D.: Peripheral Obliterating Arteritis as a Cause of Triplegia Following Hemiplegia, J. Nerv. & Ment. Dis. **34**:42 (Jan.) 1907.

6. Hunt, J. R.: Intermittent Claudication and Allied Syndromes Due to Angiosclerosis of the Extremities, M. Rec. **67**:801 (May 27) 1905; The Lumbar Type of Intermittent Claudication, Am. J. M. Sc. **143**:173 (Feb.) 1912; The Ischemic Lumbago: A Further Contribution to the Lumbar Type of Intermittent Claudication, J. A. M. A. **62**:671 (Feb. 28) 1914.

7. Oppenheim: Deutsche Ztschr. f. Nervenh. **17**:317, 1900.

8. Determann: Deutsche Ztschr. f. Nervenh. **29**:152, 1905.

9. Ortner: Wien. klin. Wchnschr. **19**:718, 1906.

10. Rosenfeld: Deutsche med. Wchnschr. **32**:1059, 1906.

11. Dejerine, J. J.: Sur la claudication intermittente de la moelle épinière, Rev. neurol. **14**:341 (April 30) 1906.

in intermittent claudication of peripheral origin, with the fundamental distinction that in the first affection it is the spinal cord and in the second the muscles which are concerned. In both instances, it is an ischemia which induces the symptoms. For spinal intermittent claudication, the spinal cord, sufficiently nourished during rest, is no longer so during prolonged effort and evidences this ischemia by functional insufficiency with resulting paralysis and dysesthesia at this time. There is a very marked functional disturbance of the pyramidal tract, with complete paralysis of one or both lower extremities and exaggeration of the tendinous reflexes, spinal trepidation, sometimes the Babinski sign and also painful sensations, phenomena which disappear entirely after several moments of rest."

Eventually, after months or years, sclerotic changes in the cord occur in spinal claudication, and various syndromes indicative of organic and progressing disease arise.

Regarding the pathologic changes of intermittent claudication in general, it is believed that an associated vasomotor neurosis supplements the organic changes in the arterial walls. According to Hunt, "the two chief factors, angiosclerosis and angioneurosis are usually combined," although Oppenheim recognizes a benign, purely functional type due to vascular spasm."

The pathologic changes of the types of the condition of which I shall speak rest on sclerotic changes in the cord. A broader conception of the neurologic aspect of the subject should include changes in the peripheral nerves themselves due to disease in the minute arterial twigs supplying them. I have nothing to offer, unfortunately, on this special phase beyond saying that I have not found any case in which clinical evidence showed a peripheral nerve type of sensory or motor disability.

For purposes of clarification, one can trace the abdominal aorta and its distributions, and correlate the clinical evidence of claudication at different sites. At the level of its intercostal branches, owing to the fact that some of their divisions go to supply the cord, there are, in some cases, (1) such transitory spinal phenomena as Dejerine first described and (2) after a sufficient duration, persistent neurologic signs of loss of integrity of certain facts and centers of the cord. At the level of the lumbar branches there is induced the ischemic lumbago described by Hunt. This syndrome in pure form, as Hunt described it, lacks spinal signs, although extension of the process into branches of the upper lumbar arteries may give rise to them parallel with changes in the conus medullaris. Localization in the branches of the lower lumbar arteries and in the lateral sacral arteries should produce, in turn, a cauda equina syndrome on a vascular basis; a situation which, as far as I know, is extremely rare. In the lower reaches of the arterial tree, that is, in the common iliac, external iliac, femoral popliteal and terminal divisions, if

the claudication is confined to these sites, typical intermittent claudication of the pedal type without neurologic complications results.

According to Dejerine, the late sclerotic changes in the cord produce a spastic paraplegia. In my series, one patient had developed well marked paraplegic symptoms of a spastic character, and another was alined in this category by signs of partial disturbance of the upper neurons. On the other hand, some degree of flaccid paraplegia was present in three other patients; this marks the divergence of neurologic conditions which can be induced.

In four patients, there were no abnormal neurologic signs. The symptoms, typical of claudication, were due to disease in the peripheral arteries. Since this type is fairly common, has been well described in

Fig. 1 (case 1).—Shadow due to arterial calcification indicated by arrows.

the literature and is without special neurologic interest, these four patients will be omitted from discussion except in regard to one feature. It is not always possible to demonstrate arteriosclerotic changes by roentgen ray even when there are gross abnormalities of pulsation in the peripheral arteries and when the symptoms are in every respect typical of claudication. One woman, aged 55, for a year suffered from excessive pain in the legs which developed after walking more than a block. It would go away promptly when she sat down. She was an excessive user of tobacco and of alcohol, and had marked hypertension and evidence of nephritis. She had had the symptoms of claudication for one year. During the subsequent year, uremia developed and led to death. In this patient, pulsation could not be detected in either posterior tibial, or in the left dorsalis pedis and was weak in the right dorsalis pedis; yet

the rays did not reveal definite evidence of calcified vessels, the only suggestion being the presence of a few flecks extending below both sacro-iliac joints due possibly to minute deposits in the walls of the internal iliac arteries. Owing to the fact that angiospasm supplements angiosclerosis in these conditions, but also because x-ray examination does not reach satisfactorily every portion of a large arterial tree, it is not always possible to procure visual proof by x-ray pictures. It is certainly true that negative roentgen-ray evidence should not exclude the diagnosis in otherwise typical cases.

In the patients in whom neurologic signs were present, there were none in whom I found spinal signs only during a crisis of the disease. My patients, however, were not seen during acute crises. They were almost all examined in clinic practice where it was not possible to subject them to the walking necessary to bring on a crisis of claudication. I do not doubt that such test procedures would uncover transitory neurologic signs and reveal also that fluctuations in degree of existing signs can be induced. On the other hand, I have seen temporary neurologic signs which gave promise of being permanent until they responded to rest and change in regimen.

REPORT OF CASES

CASE 1.—F. S., with intermittent claudication and arteriosclerosis in the legs (fig. 1), had an abnormal plantar response on one side and moderate impairment of vibratory sensation when first examined. After a few days in bed, these neurologic signs disappeared and were still absent when the patient was again examined two months later.

THE SPASTIC GROUP

Two patients showed persisting signs either of a spastic paraplegia or of upper neuron changes of some degree.

CASE 2.—*History.*—E. L., a fireman, aged 49, was first seen in February, 1926, when he complained of weakness of the legs, with numbness, burning and tingling pain, "a sort of band around each knee" of one year's duration. It was subsequently found that the symptoms were induced by walking. A later additional symptom was difficulty in starting micturition. He had had malaria thirty years previously and also gonorrhea, but he did not give a history of syphilis; a year prior to the onset of the present symptoms he had had cholecystitis and appendicitis and suffered from severe chronic constipation. He formerly used beer in moderate excess and customarily smoked at least six cigars a day.

Examination.—The patient was admitted to the Neurological Service of the Bellevue Hospital where he showed a partial paraplegic syndrome with weakness of the legs, great difficulty in walking and fluctuations in this occasioned by pain. This was accompanied by hyperactive knee and ankle reflexes with a doubtful kind of plantar response on both sides and by absence of all abdominal reflexes. There was moderate atrophy in the legs and fibrillations in the calf and quadriceps muscle.

The sensory status was normal except for diminution of the vibratory sense in the legs and in the pelvis. Disturbance of postural sense, presence of which one

might expect, was not found, presumably because the tests do not match the tests for vibration in delicacy. Pulsations in the posterior tibial arteries were small, and a pulse was not discernible in either dorsalis pedis artery. The feet were cold but not cyanotic and there was nothing remarkable about the appearance of the skin. Roentgenograms showed calcifications in the vessels of the legs and pelvis (fig. 2).

Fig. 2 (case 2).—Showing calcifications, indicated by arrows.

Laboratory Tests.—The results of the laboratory tests appear to prove that the spinal cord signs were actually on an arteriosclerotic basis parallel with the strictly peripheral observations. Syphilis of the cord was excluded from the diagnosis by serologic results consisting of a negative Wassermann reaction of the blood and spinal fluid, absence of cells or globulin in the fluid and an entirely normal colloidal gold curve. Neoplasm of the cord was excluded by the absence of a sensory level and by the entirely normal spinal manometric readings. As regards a possible subacute combined sclerosis, the following blood picture was obtained:

hemoglobin content, 100 per cent; red cells, 4,640,000, with good morphology; white cells, 7,600 with a normal differential count. Fractional gastric analyses gave a fasting free hydrochloric acid of 32; one hour after the meal it was 65; the total acidity ranged between 57 and 80. The phenolsulphonphthalein test yielded only 35 per cent in two hours, but the results were normal in a water dilution test, and the urine was free from albumin, sugar and casts. The blood pressure was 140 systolic. The vessels of the ocular fundi were sclerotic.

Comment.—This patient showed signs of intermittent claudication of the legs and signs of arteriosclerosis in the spinal cord. The latter changes involved the posterior columns, as evidenced by the disturbance of vibratory sensation, and the lateral columns as shown by the hyperactive knee and ankle reflexes and by the condition of the plantar reaction. It was predominantly, on the motor side, a spastic syndrome of the upper motor neuron, although a moderate involvement of the lower neuron was also present. The patient appeared, therefore, to belong fundamentally to the spastic paraplegic group of Dejerine.

Case 3.—*History.*—A woman, aged 60, single, a school teacher, complained of tingling of the legs. Walking induced paresthesia and made the legs feel as if needles were sticking into them. This condition was relieved immediately by resting. She had had scarlet fever at the age of 11 and tonsillitis more than once before the tonsils were removed at the age of 30. She had never used any alcohol and had used little coffee or tea; she was said to have been a light eater all her life.

Examination.—There was considerable increase in all deep reflexes with preservation of the abdominal reflexes. The plantar response on the left was normal, but on the right there was a potential Babinski sign, that is, distinctly less flexion than on the opposite side. The patient felt cotton touch and heat and cold everywhere. Postural sense in the toes was normal. There was, however, diminution of vibratory sensation at the ankles. The strength and tonus in the legs was not remarkable; gait and station were normal. Pulsations in the dorsalis pedis and posterior tibial arteries were greatly reduced at the first examination and two months later were absent. The feet were cold to the touch but were not cyanotic and did not present any trophic changes.

A diagnosis of possible subacute combined sclerosis was first made in view of the evidence of combined involvement of the posterior and lateral tracts of the cord. However, examination of the blood gave normal results, and the changes in the pulsations in the peripheral arteries were not consistent with that condition. Incidentally, the Wassermann test of the blood was negative. The spinal fluid was not examined. The blood pressure was 146 systolic, and 84 diastolic. Roentgen-ray films of the pelvis and legs did not show definite evidence of arterial calcification, though in the left side of the pelvis two lines of increased density were possibly significant.

Comment.—This patient is included in the group under consideration because intermittent paresthesia was induced by walking and relieved by sitting down, because the pulsations in the peripheral arteries were distinctly abnormal and because slight but definite spinal signs were present without other conflicting etiology. Negative evidence with

x-ray studies, as already stated, does not exclude a diagnosis of intermittent claudication. The spinal syndrome in this case resembled that seen in the preceding patient, though considerably less in degree and without evidence of any damage to the anterior horn cells. With the first case, in which positive signs were more amply provided, it indicates that posterior column and pyramidal tract signs, with or without evidence of slight damage to the lower motor neuron, constitute one type of spinal syndrome accompanying intermittent claudication.

THE FLACCID TYPE

CASE 4.—*History.*—A lawyer, aged 68, who was seen first in 1924, for a year had been likely to have pain in the left leg the first thing in the morning; it would usually wear away by 1 p. m. A diagnosis had been made of sciatic neuritis. Rest in bed and electrical treatments had given some relief. Three days before examination, the patient had developed severe pain in the right leg while walking, and immediately the symptoms in the left leg had disappeared. The patient commented on the fact that it was necessary only to rest a few minutes to drive the pain away completely. Shortly afterward, it was discovered that there were no pulsations in either the dorsalis pedis or the posterior tibial artery. Later, it became more apparent that walking was required to bring on the severe paroxysms of cramplike pains.

The previous history in this case was not particularly striking. The patient had had a severe attack of pneumonia ten years previously, and just prior to the appearance of the present symptoms he had been anemic, with a high color index and variation in the size of the red cells. Subsequent events proved that this condition was not an incipient primary anemia. History of urologic disorder was absent. He had used alcohol steadily all his life, though never to excess. He smoked from fifteen to twenty cigarets a day, and had one habit which seemed to have some possible bearing on the condition: he had done a great deal of long distance walking.

Examination.—There was marked general arteriosclerosis, though the blood pressure averaged 150 systolic and 90 diastolic. The radial arteries evidenced a marked degree of sclerosis on palpation. The pulse was absent in each dorsalis pedis and posterior tibial artery. There was also moderate emphysema and slight cardiac enlargement with a systolic murmur heard all over the chest. At a later date, cardiac signs were indicative of mitral regurgitation, aortic atheroma without signs of actual aortic stenosis and partial fibrillation. Examination of the blood revealed: hemoglobin content, 85 per cent; red cells, 5,680,000; white cells, 6,450; polymorphonuclear cells, 57 per cent, lymphocytes, 30 per cent; large mononuclear cells, 10 per cent, and eosinophil cells, 3 per cent. The Wassermann reaction of the blood was negative. A urologic examination did not give evidence of prostatic adenoma or carcinoma. Urinalysis revealed: acid reaction, slight cloudiness, specific gravity 1.020, very faint trace of albumin, no sugar, no acetone or diacetic acid, no bile pigment or excess of indican, no casts, a few scattered red cells, white cells, bladder cells and mucus threads. The phenolsulphonphthalein test resulted in an output of only 35 per cent in two hours. Similar, and somewhat lower, figures were repeatedly obtained during later stages of the illness. The urea nitrogen of the blood was 17.2 mg. per hundred cubic centimeters; urea, 37 mg.; uric acid, 2 mg.; sugar of the blood measured 105 mg. Roentgen-ray examination of the pelvis and legs showed the bones to be normal in outline and structure.

There was evidence of arteriosclerosis in the pelvic arteries, and numerous calcified plaques were present in the abdominal aorta (figs. 3 and 4). The sclerosis extended into the femoral arteries and was clearly defined in the popliteal and posterior tibial arteries, a little more marked in the left leg than in the right.

Neurologic Examination.—In 1924, when the condition was first diagnosed, both ankle reflexes were weak but neither was absent. Both knee reflexes were strong.

Fig. 3 (case 4).—Showing arteriosclerotic changes.

One could not find hypesthesia. The sacral area was normal. Postural sense was present in the toes, and vibratory sense was well preserved over the malleoli. Paresis, muscular atrophy or fibrillations were not present. Two and a half years later, the ankle reflexes had disappeared. An intercurrent hypesthesia had appeared over an area corresponding to the right fourth and fifth sacral segments. It came on suddenly; following this it diminished steadily in intensity and extent. A year later, the knee reflexes as well as the ankle jerks were not obtained. The

plantar responses remained flexion throughout. There was never any alteration in the abdominal reflexes or in the arm reflexes. A partial right foot drop, slowly progressive, had appeared with noticeable weakness of the upper leg and some weakness also of the left leg. Fibrillations were present and were most conspicuous in the gluteal and right posterior thigh muscles. The electrical reactions were altered; throughout the right leg, including the gluteal group of muscles, it was possible to demonstrate a partial reaction of degeneration—absence of faradic response and sluggish and weak response to galvanism. With this, vibratory sense had become impaired below the knee and there was a moderate impairment of

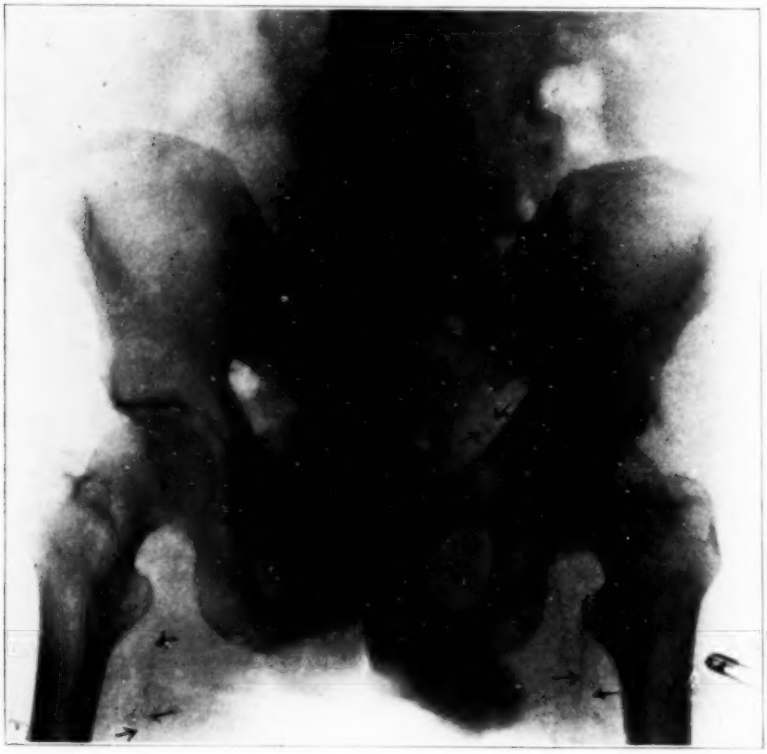

Fig. 4 (case 4).—Remarkable degree of calcification in the pelvic and femoral vessels.

postural sense in the toes, with good preservation, however, of tactile, pain and thermal forms of sensibility. Control of the bladder was not at any time impaired, but recently control of the anal sphincter frequently failed.

Course.—As a result of therapy of various kinds, considerable control of the symptoms was obtained over a period of approximately three years. The severe cramps in the legs induced by walking were eliminated, though the severe discomfort on arising persisted. Lumbar pains of the nature of lumbago—considered to be examples of the ischemic lumbago described by Hunt—were present, but their severity was kept under fair control. Later, parallel with the conspicuous increase in spinal cord signs, there was an exacerbation, difficult to relieve, in the pains and general discomforts.

Comment.—Case 4 demonstrates the slow development in a man with peripheral claudication of a predominantly poliomyelitic syndrome based presumably on sclerotic changes involving the anterior horn cells, but with evidence of some additional damage to the posterior columns. It shows that spinal arteriosclerosis giving rise to intermittent claudication does not always affect the lateral columns and does not necessarily produce a spastic paraplegia.

CASE 5.—*History.*—A man, aged 75, married, a carpenter, showed symptoms due to two concomitant processes, as shown by x-ray pictures, namely, a chronic osteo-arthritis involving the vertebrae, and marked arteriosclerosis of the abdominal aorta. He complained of pains in the legs, continuous in nature though with much variation in intensity. Pain was present when he was in bed and when he was quiet, but it was greatly increased by walking. The pain became so bad if he walked a few blocks that he had to sit down. He had not had any bladder trouble. He complained of coldness of the feet and also of numbness of the hands. The previous history was unimportant except for a gastric ulcer at the age of 55 which was successfully treated. History of venereal disease was not obtained. He used alcohol in moderation, but for a long time had used tobacco rather heavily.

Examination.—Signs of general arteriosclerosis were noted, but with a low blood pressure, the systolic pressure being only 125. Pulsations were felt in the dorsalis pedis and posterior tibial arteries, but with a possible reduction on the right side. Neurologically, the observations were limited to reduction of the right abdominal reflexes, absence of the knee and ankle reflexes, and a slight diminution of vibratory sensation at the ankles. The Babinski sign was not elicited. Atrophy and fibrillation were not noted. The power in the legs was poor but was in fair accord with the general strength. All forms of sensation except the vibratory were normal. There was not any disturbance of the vibratory sensation in the hands.

The Wassermann reaction of the blood was negative. Urinalysis gave normal results. The hemoglobin content was 85 per cent; red blood cells, 4,830,000; white blood cells, 7,500; polymorphonuclears, 70 per cent; lymphocytes, 28 per cent; large mononuclear cells, 1 per cent, and monocytes, 1 per cent; the spinal fluid was clear and colorless, contained two cells and no globulin and gave a negative Wassermann reaction and a colloidal gold curve of 0011110000. There was not any evidence of spinal block. Roentgen-ray examination demonstrated chronic osteo-arthritis of a productive type with exostoses about the articulating surfaces. Arteriosclerosis was present in the pelvic arteries.

Comment.—A normal spinal fluid, absence of any indication of block and absence of either primary or secondary anemia suffice to exclude the diagnosis of spinal syphilis, spinal tumor or an atypical syndrome allied to subacute combined sclerosis. The pulsations in the peripheral arteries of the legs were present. Reference to Dejerine recalls that this symptom is compatible, however, with spinal intermittent claudication. Therefore, in view of the symptoms of claudication and the arteriosclerosis shown by x-ray pictures, the diagnosis of spinal arteriosclerosis as the cause of the spinal signs seems warranted. The chronic osteo-arthritis also present was not without symptoms; no doubt it caused the persist-

ing pains and discomforts, but it did not bring about the intermittent attacks occasioned by walking and did not cause the disappearance of the deep reflexes.

The condition in this patient parallels the syndrome in the preceding case, though in an earlier stage of the picture, and supplements that case in showing that a poliomyelitic syndrome can arise on a basis of spinal arteriosclerosis associated with intermittent claudication.

In another patient with definite peripheral intermittent claudication, typical in symptomatology and demonstrable by the x-ray pictures, there was an isolated lower motor neuron sign consisting of the absence of one ankle reflex. This patient, however, also had diabetes, and it is impossible to conclude on clinical evidence whether this change in a reflex was due to arteriosclerotic involvement in the anterior horn or to disorganization of the reflex arc on the basis of the diabetes.

SUMMARY

This article, based on the observation of ten patients with intermittent claudication, outlines the neurologic signs in six.

Transitory neurologic phenomena due to transient spinal ischemia in the precise form described by Dejerine were not demonstrated in this series. On the other hand, it is indicated from this series of patients that, on a basis of secondary spinal sclerotic changes, permanent and progressing signs arise and constitute two outstanding and contrasting spinal syndromes. These are: (1) a predominantly spastic paraplegic syndrome, and (2) a predominantly poliomyelitic syndrome. In each there is, in addition, moderate involvement of the posterior columns.

Impairment of control of the bladder may be present but is not common. It occurred in only one patient and was conspicuously absent in a patient with a poliomyelitic syndrome of severe type. Serious weakening of the anal sphincter may develop.

INTRAMEDULLARY CYST OF THE SPINAL CORD ASSOCIATED WITH A CIRCUMSCRIBED INTRAMEDULLARY TUMOR

REPORT OF A CASE *

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The combination of an intramedullary cyst of the spinal cord with a circumscribed tumor of the spinal cord is rare, and the relation between the two conditions is of considerable interest. The case which we report illustrates the combination of such lesions. In discussing it, we shall exclude those cases of a gradually progressing central gliosis with cavity formation (referred to as syringomyelia) and limit ourselves to definite neoplastic processes. In regard to such an association little is found in the text books. Frazier [1] stated that gliomas of the cord (unlike those of the brain) rarely contain cysts. Elsberg [2] merely stated that cysts of the cord have been found. Bruns [3] stated that gliomas of the cord tend to grow lengthwise and to become cystic. Cysts of the cord have been found, however, with various types of tumors, both intramedullary and extramedullary.

REPORT OF CASE

History.—W. C., a white man, aged 47, was first seen on Nov. 8, 1927. His first symptoms had begun, in 1921, with sharp intermittent pains in the soles, "as if a nail were being driven into the feet"; these pains were increased by pressure, as on standing. The pains gradually decreased but were followed by constant tingling and cold sensations in the feet, which persisted. In 1924, he complained of a girdle sensation "as if the stomach were drawn tight to the spine," which lasted for several months. At the same time, there were sharp intermittent pains in the back of the neck; these lasted about a month and recurred several times during the three following years. He did not have further symptoms until about six months before examination; at that time, he developed a cold and numb sensation in both lower extremities, extending up to the region of the hip. The girdle sensation then returned, and he felt "as if the stomach were blown up and would burst." His legs gradually began to grow weak, so that he would drag his feet

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1. Frazier: Surgery of the Spine and Spinal Cord, New York, D. Appleton and Company, 1918.

2. Elsberg: Diseases of the Spinal Cord and Its Membranes, Philadelphia, W. B. Saunders Company, 1916.

3. Bruns: Geschwülste des Nervensystems, ed. 2, 1908.

after walking about half a mile, and his gait would become unsteady. Slight difficulty in urination occurred, and also sexual impotence. He complained at this time also of a cold and numb sensation along the ulnar aspect of the right hand and forearm, most marked in the little finger.

Although he did not give a history of syphilis, he said that his spinal fluid had been examined in 1921, and that the Wassermann reaction had been 2 plus. Several Wassermann tests of the blood had been reported negative. In 1926, he had been given eighteen intravenous injections of neoarsphenamine and a few intramuscular injections of mercury and bismuth, without any benefit. An examination of the spinal fluid had been made in March, 1927, and the Wassermann reaction had been negative. The family history was unimportant, except that a sister had died of carcinoma of the breast; his wife had had one miscarriage but was now in good health, as were the two children. His past history was unessential.

Examination.—The patient was well developed and well nourished. The pupils were round and equal, and reacted normally; the ocular fundi were normal; there were no palsies of the cranial nerves. Weakness was not present in the upper extremities, and there was only slight weakness in the lower extremities. There were slight ataxia in the finger-to-nose test with the eyes closed, a positive Romberg sign and a slightly ataxic gait. The biceps and triceps reflexes were normal; the knee and achilles reflexes were increased. There was a bilateral Babinski and Chaddock reflex, and also a positive Schaeffer and Oppenheim reflex on the right side. The umbilical and cremasteric reflexes were not obtained. There were no sensory changes in the upper extremities, except a hyperalgesia along the ulnar aspect of the right hand. He felt touch and painful stimulations in the lower extremities quite normally, except for slight delay in appreciation of pain. Over the trunk, there was complete anesthesia to touch, pain and temperature senses, from the region of the second to the eleventh dorsal segments (fig. 1). Joint sense was lost in the toes of both feet. Vibratory sense was lost in both lower extremities and up to the second rib in front. Deep pain sense on compression of the achilles tendons was lost.

The spinal fluid was clear and colorless under 90 mm. (water) of pressure; on prolonged jugular compression there was not the slightest rise in spinal pressure, indicating a complete spinal block. The spinal fluid contained 3 cells per cubic millimeter, and a marked increase in globulin. The Wassermann and colloidal gold tests gave normal reactions. A roentgen-ray examination gave normal observations.

Clinical Diagnosis.—The diagnosis was compression of spinal cord probably by a neoplasm in the lower cervical region.

First Operation, Nov. 14, 1927.—Laminectomy was performed with removal of the posterior arches of the fifth, sixth and seventh cervical vertebrae. The dura was of normal thickness, but there were a few fine adhesions between the dura and the arachnoid. The spinal canal was larger than normal; there was faint pulsation of the dura. When the dura was opened, there was no escape of cerebrospinal fluid; the spinal cord completely filled the enlarged spinal canal. A tumor was not found on the surface of the cord. The cord was soft and fluctuated on palpation. The cord was punctured in the midposterior region and 10 cc. of faintly yellowish fluid escaped; the fluid did not coagulate. The cord was then incised in the midposterior region and a large cyst exposed, measuring fully 15 mm. in diameter; there was only about 2 mm. of cord tissue surrounding the cyst posteriorly. There

were a few fine trabeculae across the upper portion of the cyst; there was no evidence of neoplasm in the wall of the cyst, which did not seem to have a definite lining. After evacuation of the cyst the cord collapsed as a bag. The cyst extended upward beyond the exposure; below, it ended at about the first thoracic segment. After evacuating the cyst, the wound was closed.

Course.—Following the operation the patient complained of severe pains in both hands and forearms. Several days later, a spinal puncture was done and the Queckenstedt test repeated. It was found that a complete spinal block was still present.

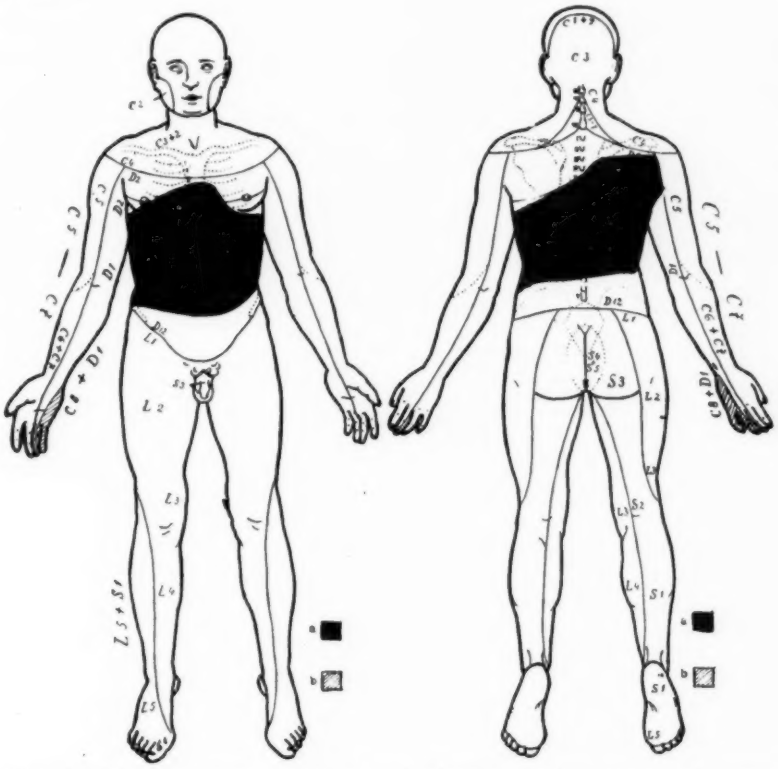

Fig. 1.—Diagram (ventral and dorsal views) showing extent of sensory changes in patient W. C.; *a* indicates areas in which touch, pain and temperature senses were lost; *b* shows areas of hyperalgesia.

Second Operation, Nov. 25, 1927.—The wound was reopened and extended so as to include from the second cervical to the second dorsal vertebrae. At the level of the third thoracic segment, below the cyst (fig. 2), the cord appeared thinned out and translucent posteriorly. A midposterior incision was made, and an intramedullary tumor, measuring about 1 by 1.5 cm. was easily shelled out. The tumor was soft and well circumscribed. Anteriorly, however, it was intimately related to the cord substance.

Pathologic Examination of the Tumor (Dr. E. L. Bishop).—The specimen of tissue measured approximately 1 by 1.5 cm. It was somewhat friable and

apparently extremely vascular. No capsule was seen; there was no gross evidence of necrosis or cyst formation. Sections of the tumor, stained by hematoxylin and eosin, showed a cellular and vascular structure. The cells were of medium and fairly large size; the cytoplasmic outline was indistinct, and appeared as a hyaline ground substance. The cells were closely compacted and apparently without fibers. Roset and pseudoroset formations were absent. The nuclei were vesicular and hyperchromatic. Their nucleoli were very small and were not always found. Mitoses were infrequent. The cells surrounded numerous small and poorly formed vessels, filled with blood. The cells at times radiated and encircled the blood

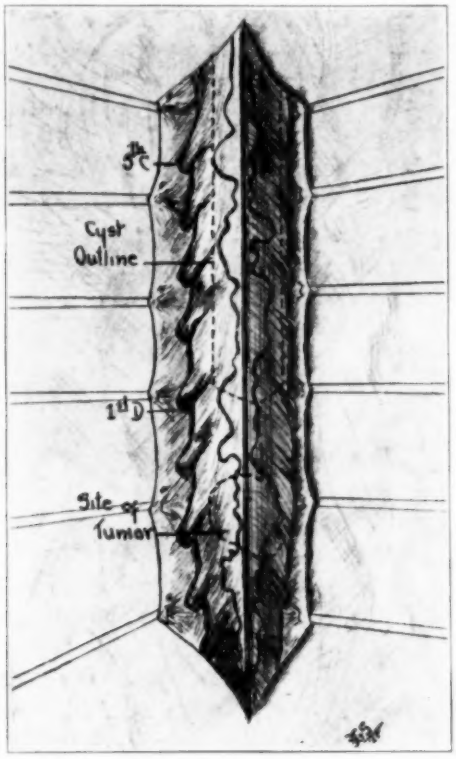

Fig. 2.—Position of the cyst and tumor.

spaces, being in contact with the blood, and there was also considerable free blood among the cells. Slight edema was present, but there was no necrosis or other degenerative change. The connective tissue was extremely scanty and limited to the vessels (Perdrau's method). Differential staining (Hortega, phosphotungstic-acid-hematoxylin, etc.) failed to show the presence of neurogenic elements in the tumor, such as cell processes, blepharoplasten, centrosomes, etc.

Diagnosis.—The condition was diagnosed as sarcoma. While there was the possibility of this being a metastatic tumor, in the absence of a demonstrable primary tumor it must be considered as primary in the cord and probably arising from the wall of the vessel.

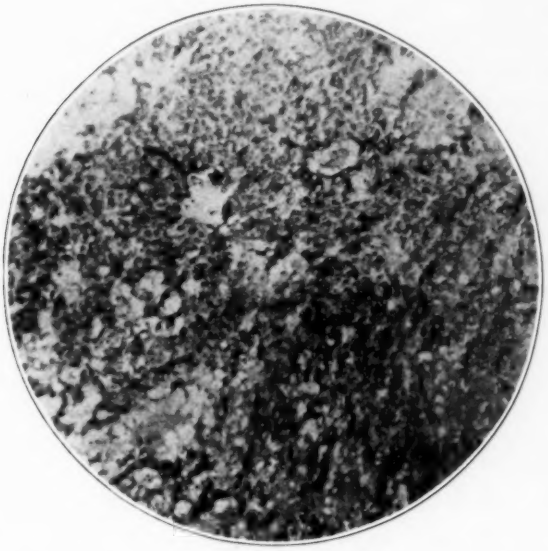

Fig. 3.—Section of the tumor under low power (hematoxylin and eosin stain), showing arrangement of cells around spaces filled with blood.

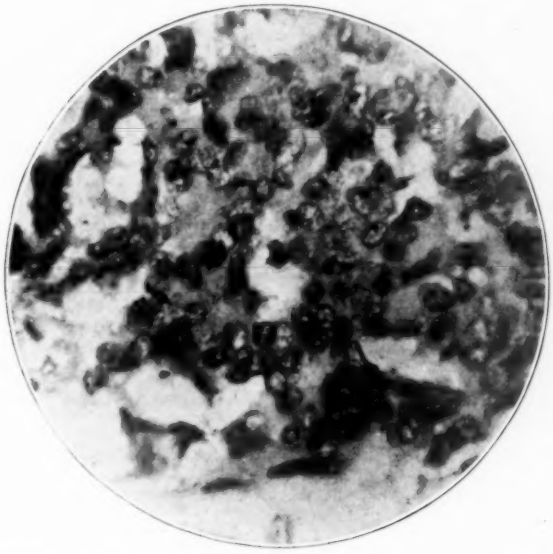

Fig. 4.—Section of the tumor under high power (hematoxylin and eosin stain), showing type of cells.

Course.—The patient made an uneventful recovery from the operation. Before discharge from the hospital he was given a series of roentgen-ray treatments. He was last examined on March 18, 1928. The cold feeling in the ulnar aspect of the right hand and the girdle sensation were still present. He had good control of the rectal and urinary sphincters. Sexual impotence had disappeared. He had no pain. Sensory changes were found over the trunk, as before the operation. The abdominal and cremasteric reflexes, however, had returned. There were neither atrophies nor reflex or sensory changes in the upper extremities. He could make all movements of the lower extremities; there was no spasticity or ankle clonus; there was a suggestive Babinski reflex on both sides. Joint sense in the toes was normal. Sense of position in the legs seemed normal. The knee reflexes were slightly increased. Vibratory sense was lost in the lower extremities and up to the fourth rib. He is now up and walking about.

COMMENT

From a clinical standpoint, it is of interest that in the case reported there were no root pains over the distribution of the segments involved by the tumor. This is not uncommon in cases of intramedullary neoplasms. There were, however, pains in the cervical distribution over the segments involved by the cyst. The pains in the feet are difficult to explain. The preservation of pain and temperature senses in the lower extremities is also of interest. This is probably explained by the fact that the fibers carrying such sensations from the lower part of the body, after decussation, ascend in the more lateral portion of the anterolateral tract; the tumor, being central, affected first the pathways for these sensations from the higher levels. The preservation of touch in the lower extremities is probably due to the fact that this sensation ascends by more than one pathway, one of which was not involved. The value of the Queckenstedt test in the diagnosis of lesions of the spinal cord is shown in this case, and also the fact that one should not be misled by a laboratory report of a positive Wassermann reaction. The absence of clinical evidence of neurosyphilis and the normal number of cells in the spinal fluid with the increased globulin content should have made one cautious in the diagnosis of syphilis. It is remarkable that the patient did not have more symptoms in view of the pathologic changes found. Still more remarkable is the degree of recovery following removal of an intramedullary tumor. The abdominal and cremasteric reflexes returned; joint sense returned in the toes; the patient recovered sexual potency; there was absence of paralysis and sphincter disturbance. Finally, it is suggested that the observations of such a cyst in the cord should arouse suspicion that a neoplasm is present, and careful examination should be made before one concludes that a tumor is not present below or above the cyst.

Chief interest, however, lies in the mechanism of the cyst formation. In most of the cases of this type reported the cysts have been small,

usually microscopic. A large cyst, as in our case, under tension sufficient to block the flow of spinal fluid appears to be unique. Cysts in the cord may occur at the site of compression, owing to softening from edema, ischemia or hemorrhage, with both intramedullary and extramedullary tumors. Our interest is in those which occur above, or below, or both above and below the site of a tumor. These cavities may consist of a dilated central canal, or they may communicate with the central canal or be entirely separate from it. They are usually located in the posterior gray matter behind the central canal. They may be lined with epithelium or dense neuroglia tissue or have no lining. Schlesinger [4] stated that the cavities may be primary, secondary to, or coordinate with the development of a tumor. The cavities probably do not all have a uniform pathogenesis. In the literature, one finds the following types of cysts:

1. *Cavities Due to Cystic Degeneration of a Long Intramedullary Tumor, Usually a Glioma.*—These cases are closely related to syringomyelia and are difficult to separate from that disease. Whipham [5] reported a case of glioma in which the central part of the entire cord was cystic and filled with a gelatinous material. Schule [6] described a case of glioma in the region from the sixth to the eighth dorsal segments with a gliomatous cyst below, extending to the twelfth dorsal segment. Westphal [7] has described a case of a glioma in the lower dorsal cord with a gliomatous cyst above, extending to the medulla. Glaser [8] considered the tumor in his case to be an angiosarcoma extending throughout the cord, with many cavities due to softening and hemorrhages.

2. *Cavities Due to a Combination of a Typical Syringomyelic Gliosis with an Intramedullary or an Extramedullary Tumor.*—In most of these cases, the two conditions have been considered as developing independently, based on a disturbance of development with faulty closure of the neural tube. Bickel [9] described a case of an ependymal glioma extending from the third cervical to the first dorsal segments, with a central gliosis above and below and with cavities at numerous levels. Jumentié [10] reported a case of an ependymal glioma in the lumbosacral

4. Schlesinger, H.: Die Syringomyelie, Monograph aus dem Neurolog. Inst. an der Wiener University, 1902.

5. Whipham, T.: Tumor (Glioma) of the Spinal Cord and Medulla Oblongata, Dilatation of the Lymphatics, Large Cavity Occupying the Position of the Central Canal (Syringomyelia), Tr. Path. Soc., London **32**:8, 1881.

6. Schule: Neurol. Centralbl. **16**:620, 1897.

7. Westphal: Arch. f. Psychiat. **5**:90, 1874.

8. Glaser, G.: Ein Fall von centralem Angiosarkom des Rückenmarks, Arch. f. Psychiat. **16**:87, 1885.

9. Bickel, M. G.: Contribution a l'étude des tumeurs de la moelle épinière et de la syringomyélie, Ann. de méd. **10**:253 (Oct.) 1921.

10. Jumentié, J.: Rev. neurol. **34**:741 (Dec.) 1927.

cord, with gliosis above and below, and a large cyst extending above to the tenth dorsal segment. In Stertz's [11] case, the gliosis and cavity were also above a glioma. In Reisinger's [12] case, cavities were both above and below, surrounded by a gliosis. Holmes and Kennedy [13] also reported a case of ependymal glioma in the middorsal region with glosis and cavity formation above. Ransom [14] reported an "adenoglioma" in which the central part of the entire cord was cystic. Among the cases of extramedullary tumor with a central gliosis may be mentioned the case of Alexandroff and Minor,[15] in which there was an endothelioma at the level of the fifth and sixth cervical segments, with a dilated central canal and central gliosis below the tumor. Heverroch [16] reported a similar case, the tumor being a neurofibroma. It seems to be typical of the cases of neuro-epithelioma, as reported by Rosenthal,[17] Kling,[18] Schlapp,[19] Hartwell [20] and others, that a central gliosis with cavity formation occurs. In some of the cases of this type it has been considered that the compression of the cord, by causing circulatory changes and deficient nutrition of the gray matter, leads to neuroglial proliferation and is therefore the cause of the gliosis. This view was held by Riedel [21] in his case of a neuro-epithelioma of the upper dorsal region with gliosis and cavity formation above and below, and also by Orlowski,[22] who reported a case of endothelioma of the dorsolumbar region with gliosis and cavities in the dorsal cord.

3. *Cavities Consisting of a Dilated Central Canal.*—Here again, there have been two views in regard to the genesis of this condition. According to the one, the dilated central canal is an independent condition, a congenital hydromyelia. It is well known that a congenital hydromyelia

11. Stertz: Neurol. Centralbl. **25**:424, 1906.

12. Reisinger: Ueber das Gliom des Rückenmarks. Beschreibung eines hierhergehorten Falles mit anatomischer Untersuchung von Prof. Marchand, Arch. f. path. Anat. u. Physiol. u. f. klin. Med., vol. 98, no. 3, p. 369.

13. Holmes and Kennedy: Syringomyelia Without Symptoms Associated with Intracranial and Spinal Tumors, Proc. Roy. Soc. Med. **2**:4, 1908-1909.

14. Ransom, W. B.: J. Path. & Bact. **2**:364, 1906.

15. Alexandroff and Minor: Neurol. Centralbl. **15**:1048, 1896.

16. Heverroch, A.: Rev. neurol. **8**:790 (Aug. 30) 1900.

17. Rosenthal, W.: Ueber eine eigentümliche mit Syringomyelie komplizierte Geschwulst des Rückenmarks, Beitr. z. path. Anat. u. z. allg. Path. **23**:111, 1892.

18. Kling: Zeitschr. f. klin. Med. **63**:585, 1905.

19. Schlapp: J. Nerv. & Ment. Dis. **38**:129, 1911.

20. Hartwell and Stevenson: Ann. Surg. **81**:413 (Feb.) 1925.

21. Riedel: Ueber einen Fall von gleichzeitigen Vorkommen von harter und weicher Gliombildung im Rückenmark mit Syringomyelie, Deutsche. Ztschr. f. Nervenh., vol. 62, no. 3, p. 97.

22. Orlowski, S.: Syringomyélie et sarcomatose de la moelle; contribution à la pathogenie des excavations intramédullaires, Arch. de neurol. **6**:161, 1898.

may exist without symptoms (Bittorf,[23] Zabriskie[24]). Kramer[25] found that in adults the central canal was patent in 7.23 per cent. Bielschowsky and Valentin,[26] who reported a case of a subdural lipoma in the lumbar region with a dilated central canal in the dorsal and lumbar cord, considered the two conditions independent. Van Gieson[27] found in his case of a middorsal glioma a dilated central canal above and below the tumor. The other view is that the tumor by compression causes stasis in the central canal which results in a dilatation of the canal. This view is based partly on the work of Kronthal,[28] who experimentally produced dilatation of the central canal in dogs with gradually increasing compression of the spinal cord. Bielschowsky[29] favored this explanation in his case in which the central canal was dilated above a tumor of the dorsal region. He pointed out that the rarity of this condition in man is due to the fact that the canal is patent in only a small percentage of adults. If one assumes the presence of a congenital hydromyelia, communicating with the fourth ventricle so that fluid flows downward in the canal, it is easily seen that a compression of the cord could cause a dilatation of the canal above the tumor. This view was accepted by Harris,[30] who reported a case of dilated central canal in the cervical cord associated with sarcoma of the cauda, dorsal cord and pons.

4. *Cavities Due to Foci of Necrosis in the Posterior Gray Matter, Caused by Circulatory Disturbance at a Distance from the Tumor.*—This view is based on the experimental work of Lhermitte,[31] who produced, by compression of the cord in dogs, cysts due to simple necrosis above the site of compression. He believed this to be the mechanism in a case of exostoses from the occipital bone, which compressed the medulla

23. Bittorf: Ein Beitrag zur Lehre von der Entstehung von Hohlen im Rückenmark und über symtomlose Hydromyelie, Virchows Arch. f. path. Anat. **18**:520, 1905.

24. Zabriskie: J. Nerv. & Ment. Dis. **47**:35, 1918.

25. Kramer, S. P.: The Central Canal of the Spinal Cord, Am. J. Insan. **75**: 193 (Oct.) 1918.

26. Bielschowsky, M., and Valentin, B.: Ueber ein Lipom am Rückenmark mit Hydrosyringomyelie und anderen Missbildungen, J. Psychiat. u. Neurol. **34**:225 (Feb.) 1927.

27. Van Gieson: A Report of a Case of Syringomyelia, J. Nerv. & Ment. Dis. **14**:393 (July) 1889.

28. Kronthal: Neurol. Centralbl. **8**:573, 606 and 633, 1889.

29. Bielschowsky: Zur Histologie der Compressions Veränderung des Rückenmarks bei Wirbel Geschwülsten, Neurol. Centralbl. **10**:344, 1901.

30. Harris, Thomas: On a Case of Multiple Spinal and Cerebral Tumors (Sarcomata) with a Contribution to the Pathology of Syringomyelia, Brain **8**:447 (Jan.) 1886.

31. Lhermitte and Boveri: Sur un cas de cavité médullaire consecutive à une compression bulbaire L'homme et étude experimentale des cavités spinales produites par la compression, Rev. neurol. **20**:385, 1912.

and in which there was a large cyst in the cervical cord, with only 1 mm. of normal cord tissue surrounding it. This view was also favored by Dejerine and Jumentié,[32] who reported a case in which an ependymal glioma extending from the fourth cervical to the fourth dorsal segments was accompanied by a cavity above extending to the medulla and also a cavity below in the dorsolumbar cord.

In our case, without serial sections of the cord, we do not believe it possible to draw any conclusions as to the mechanism of the cyst formation. There was no indication that the cyst was due to cystic degeneration of a neoplasm. It would seem unusual for a cyst of this size and under such tension to be of the type associated with a gliosis. Whether due to a dilated central canal or whether due to necrosis from distant circulatory changes, we believe that the tumor of the cord caused a stasis of cerebrospinal fluid and contributed to the formation of the cyst and the tension of the fluid within it. Granting that this patient had a congenital hydromyelia, it would be possible that the tumor below caused marked dilatation of the central canal.

CONCLUSIONS

1. A case is reported in which a large intramedullary cyst involving the entire cervical cord was found above and separate from an intramedullary sarcoma. The cyst was under marked tension and large enough to produce a spinal block.

2. Such cysts may occur either above or below a tumor of the spinal cord (intramedullary and extramedullary) as a result of cystic degeneration of the tumor, softening of an associated central gliosis, dilatation of the central canal or foci of necrosis from vascular changes at a distance from the tumor.

3. The presence of such a cyst should suggest the possibility of a neoplasm either above or below it, and careful examination should be made before the presence of a neoplasm is excluded.

ABSTRACT OF DISCUSSION

Dr. P. Bailey, Boston: It is extremely difficult to make a pathologic diagnosis from a presentation like this with a lantern demonstration in a lighted room, without seeing a section under the microscope, but unless I am mistaken this tumor is apt to be a hemangioma or a hemangioblastoma of the spinal cord, a tumor which apparently is not exceedingly rare.

My interest in these tumors began in 1921, when a man with a cyst of the cerebellum was admitted to the Peter Bent Brigham Hospital. Prior to that we

32. Dejerine and Jumentié: Tumeur intra-médullaire de nature complexe. Prolifération épitheliale et glieuse avec hématomyélie et cavités médullaires; syndrome de compression lente de la moelle avec periode de remission et syndrome sympathique à type irritatif, Rev. neurol. **37**:1138 (Nov. 3) 1921.

had always diagnosed these tumors as gliomas, verified by cystic fluid, but the nodule in the wall of this cyst proved to be a hemangioma. We soon took out a nodule from another cyst which proved also to be a hemangioma. From that time on, everybody in the clinic made an attempt to remove always a fragment from the wall of these cysts, and the number of these hemangioblastomas has increased by leaps and bounds. Meanwhile, a study was being made of cysts of the cerebellum by a pathologist in Lund, Dr. Arvid Linden, who also discovered that many of them were hemangioblastomas and found that these hemangiomatous cysts of the cerebellum were apt to be accompanied by angiomatosis of the retina. Similar cysts also occur in the spinal cord, accompanied by cystic pancreas, cystic kidneys, etc., the whole recently in the German literature being referred to as "Lindausche Krankheit."

In one patient whom we recently reexamined, we found an angiomatosis retinae overlooked at the first examination. Another interesting fact is that the father of the patient died from rupture of a sarcomatous cyst of the cerebellum. Not only that, but his sister died from the same cause, according to the records of the Massachusetts General Hospital. Many of these cases are reported in the literature as sarcomas.

Dr. William G. Spiller, Philadelphia: The interest in this case depends on the character of the tumor. Gliomas are frequently found with cystic formation. I have seen a well defined glioma in the lower part of the spinal cord, which almost appeared as though it might have been shelled out, with a large cystic formation extending through the greater portion of the spinal cord above it.

Dr. William A. Smith, Atlanta, Ga.: We believe that this tumor is of vascular origin, but there was no evidence of neoplasm within the cyst. Furthermore, sections of the tumor did not show evidence of any type of degeneration. In removing the neoplasm, the cyst was not entered. We do not believe, therefore, that the cyst resulted from cystic degeneration of the neoplasm.

The paucity of symptoms and observations in the upper extremities, in spite of the presence of an enormous cyst in the cervical cord, is remarkable. It is known that a congenital hydromyelia of considerable size may exist without symptoms or neurologic conditions. This led us to believe that a similar condition existed in this patient and that, following the development of a neoplasm, the hydromelia became greatly distended due to stasis.

Dr. Percival Bailey, Boston: I do not believe that cysts which occur in association with hemangioblastomas are due to degeneration in the tumor, because one finds in rare cases the tumor surrounding the cystic cavity. Usually one finds a small nodule in the wall with an enormous cyst and one is astounded at the size of the cyst in comparison with the small nodule of tumor. The cyst must be formed by exudation from the vessels of the nodules of the tumor, in my opinion.

ACUTE ASCENDING MYELOMALACIA

WITH THE CLINICAL PICTURE OF LANDRY'S PARALYSIS: CLINICO-PATHOLOGIC REPORT OF A CASE *

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The original description of acute ascending paralysis was given by Landry [1] in 1859. A motor paralysis beginning in the legs extends rapidly to the arms and, within a few days, to the bulbar nerves. As additional features Landry noted the relative inconspicuousness of the sensory symptoms, the absence of sphincter disturbances and the complete lack of microscopic evidence in the spinal cord. However, with increasing experience and improvement in technic, cases were observed which necessitated a broadening of the original definition as to both the clinical and the pathologic features.

In the cases of Wappenschmidt,[2] Nauwerck and Barth,[3] Marie and Trétiakoff,[4] Bostroem [5] and Marinesco and Oettinger,[6] sensory and sphincter disturbances were more or less pronounced, and definite histologic changes were found. In the cases of Wappenschmidt and of Nauwerck and Barth, the condition resembled that of multiple neuritis. In Marie and Trétiakoff's case a diffuse "leukomyelitis" was found, while Bostroem's case presented the features of Nissl's "severe and acute cell disease." An acute ascending myelitis was the underlying pathologic condition in the case of Marinesco and Oettinger. The most frequently observed picture, however, is that of an acute poliomyelitis, as described by Stilling [7] and others.

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* From the Division of Neuropathology (Dr. Hassin) of the pathology laboratories of the Research and Educational Hospitals of the University of Illinois College of Medicine.

1. Landry, O.: Note sur la paralysie ascendante aiguë, Gaz. hebd. de méd. **6**:472 (July 29) 1859.

2. Wappenschmidt, O.: Ueber Landrysche Paralyse, Deutsche Ztschr. f. Nervenh. **16**:306, 1909.

3. Nauwerck, C., and Barth, W.: Zur pathologischen Anatomie der Landryschen Paralyse, Beitr. z. path. Anat. u. z. allg. Path. **5**:1, 1889.

4. Marie, P., and Trétiakoff, C.: Étude anatomo-pathologique de trois cas de maladie de Landry à forme médullaire, Rev. neurol. **37**:777 (July) 1921.

5. Bostroem, A.: Ueber toxisch bedingte aufsteigende Laehmung mit Haematoporphyrie, Ztschr. f. d. ges. Neurol. u. Psychiat. **56**:181, 1920.

6. Marinesco, G., and Oettinger: De l'origine infectieuse de la paralysie ascendante aiguë ou maladie de Landry, Semaine méd. **15**:45, 1895.

7. Stilling, E.: Pathologisch-anatomischer Befund bei einem Falle von Landryscher Paralyse, Arch. f. Psychiat. **46**:430, 1909.

From the foregoing statement, it would appear that Landry's paralysis does not possess a definite clinical or pathologic picture and does not represent a morbid entity. Its only diagnostic criterion, as pointed out by Oppenheim,[8] is a "flaccid paralysis which extends in rapid succession from below upward, i.e., from the legs over the trunk and the arms to the bulbar nerves." In other words, the characteristic feature of Landry's paralysis is its mode of onset and progression. The details of the clinical symptomatology and of the pathologic condition vary from case to case.

In the case here recorded, the paralysis set in abruptly in the legs and traveled over the trunk and arms upward finally reaching the medullary centers The pathologic picture was unique in that it showed an ascending myelomalacia, with involvement of almost the entire spinal cord A careful perusal of the literature failed to reveal a report of a case of such widespread myelomalacia with the clinical picture of Landry's paralysis. The only cases that could possibly be classified as myelomalacia are those of Laurès.[9] However, this author does not describe microscopic observations and mentions merely that in one case the lumbodorsal portion of the spinal cord and in another the entire cord was softened.

REPORT OF CASE

Clinical History.—On Sept. 19, 1926, a white woman, aged 30, was admitted to the neurologic ward of the Research and Educational Hospitals of the University of Illinois, complaining of pain in both lower extremities for twelve days. The pain was so severe that the patient could not bear even the weight of the bedclothes. The following day, a feeling of numbness appeared in the right foot and spread rapidly to the corresponding leg and thigh, and "stiffness" was complained of in the opposite lower extremity. Within two days, complete paralysis of both lower extremities developed and was accompanied by urinary and rectal incontinence, vasomotor disturbances and a state of general distress.

The patient had had diphtheria, measles and whooping cough. Miscarriages were denied, but after her death it was learned that an abortion had been induced a few weeks prior to the onset of the disease. Infection with venereal disease was denied. The patient admitted drinking large amounts of home made beer but denied any other bad habits. Her mother died of a "paralytic stroke," and the father of a cancer of the lip.

Examination.—The patient appeared anemic, emaciated and in great discomfort. She complained of severe headache and pain in the legs and abdomen. The lower extremities were completely paralyzed; the legs were extended and the feet abducted and markedly edematous. Passive movements were painful but did not encounter resistance. Active movements were entirely absent. The upper extremities were not paralyzed. There was no pain on passive movements, nor were there trophic or vasomotor disturbances. The tendon reflexes of the lower extremities

8. Oppenheim, H.: Lehrbuch der Nervenkrankheiten, 1923, vol. 1, p. 447.

9. Laurès, G.: Deux cas de paralysie ascendante aiguë, Arch. de méd. et pharm. nav. **106**:220, 1918.

were absent; in the upper extremities they were preserved. There was complete anesthesia to touch, pain and temperature up to the tenth dorsal segment. The rectum and bladder were incontinent. The cranial nerves were normal.

The spinal fluid was under low pressure; both Pandy and Nonne reactions were positive, and the cells numbered 338 per cubic millimeter; the Wassermann reaction was negative. Examination of the blood revealed: hemoglobin, 70 per cent; erythrocytes, 3,200,000; leukocytes, 11,400; differential count: polymorphonuclears, 76 per cent; lymphocytes, 15; large mononuclears, 5 and eosinophils, 4 per cent. A roentgenogram of the spine did not reveal changes in the bones or joints. Examination of the urine gave negative results. The pulse rate varied between 100 and 130; respiration was increased to 35 or 40 per minute, and the temperature ranged from 102 to 104 F.

Course.—September 22: The anesthesia had reached the seventh dorsal level; the patient complained of tingling and numbness in both hands. Rigidity of the neck was present. There was no disturbance of sensibility or motility in the upper extremities. There was severe pain in the neck.

September 24: The level of anesthesia had reached the fifth dorsal segment.

October 1: Muscle power was poor in both hands.

October 4: Blood cultures were negative in broth and on aerobic plate and anaerobic slant.

October 6: The level of anesthesia extended to the second rib on both sides. The right upper extremity showed marked hypesthesia and hypalgesia of the forearm. Active movements were impossible at the wrist and fingers. The wrist drooped; the fingers were flexed in the metacarpophalangeal and interphalangeal joints. The thumb was held parallel to the index finger. The arm could hardly be moved in the shoulder joint. Slight flexion was possible at the elbow. In the left upper extremity the disturbances in sensibility were less marked than on the right side. The wrist could not be extended or flexed. The fingers were flexed in all joints. There was no rigidity of the neck. The left palpebral fissure was smaller than the right.

October 8: Flaccid paralysis was complete in the upper extremities with practically complete loss of sensibility.

October 12: The anesthetic zone extended to the clavicular region.

October 26: Both lungs showed passive congestion. The respiratory difficulties gradually progressed, and death occurred on November 20.

Macroscopic Examination.—The spinal cord, especially the lower dorsal and lumbrosacral portions, appeared softened. The dura was loose and resembled a wide, floating sac enclosing the semi-liquefied organ. Transverse sections revealed, at some levels, obliteration of the normal markings between the gray and white substance and defects in the spinal cord parenchyma in the form of cavities (fig. 1). These cavities involved chiefly the white substance and were located mainly in the cervical and upper dorsal segments. In the lower dorsal and lumbosacral regions only a thick, creamy mass was seen which had completely replaced the normal structure. Some strands of tissue were preserved in the softened area, crossing it dorsoventrally in the upper dorsal segments and occupying, in the lumbosacral region, the periphery as narrow strips. In the middle and lower dorsal area they were practically absent.

Microscopic Examination.—Paraffin and celloidin sections of various levels of the spinal cord, brain stem, cerebellum, cerebral cortex and peripheral nerves (tibial and peroneal) were stained with toluidine blue, hematoxylin-eosin, van Gieson, Alzheimer-Mann, Bielschowsky, Weigert-Pal, Cajal's gold sublimate and Hortega's methods and with scarlet red.

The meninges were markedly thickened and hyperemic throughout the entire length of the cord. The adventitia of the blood vessels also appeared thickened and slightly infiltrated with lymphocytes and occasionally with polyblasts. The meningeal vascularization was especially evident at the places of emergence of the roots of the cauda equina. In some segments, especially in the upper dorsal region, numerous gitter cells were found in the subarachnoid space—in the meshes between the arachnoid trabeculae and between the roots.

The middle, lower dorsal and upper lumbar regions did not show any traces of gray matter. In the lower lumbar region, ganglion cells were seen

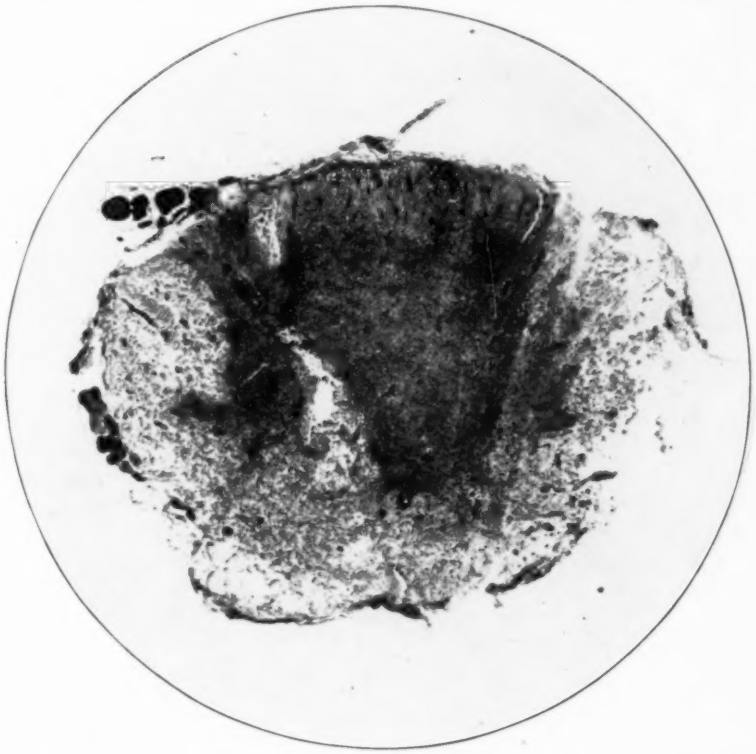

Fig. 1.—Upper dorsal region of spinal cord. Degeneration of the white and gray matter. The posterior columns are fairly well preserved. The black streaks and dots within the preserved area are blood vessels. It should be noted that the roots are not damaged. Weigert-Pal stain; × 19.

occasionally, all of them exhibiting advanced changes. The nuclei either were absent or were displaced to the periphery, while the cytoplasm was represented by an amorphous, dustlike mass which was homogenous and without a sharp and definite outline, much resembling the so-called "Zellschatten" of Nissl. The areas in which these ganglion cells were found showed a considerable number of dilated blood vessels, some of which were markedly infiltrated. The infiltrating cells were chiefly lymphocytes.

In the upper dorsal and lower cervical region, where a differentiation between the gray and white matter was possible, practically all ganglion cells showed fairly advanced changes. The best preserved cells were those of the ventromedial and ventrolateral groups, while the cells of the dorsomedial group were all badly damaged. The nuclei had disappeared; the cell bodies were shrunken, and the Nissl substance was reduced to a dustlike mass. None of the cells showed well preserved processes, and the majority contained a considerable amount of pigment. In contrast to the marked destruction of the nerve parenchyma, the glia elements exhibited progressive changes. The majority of them were so-called naked nuclei (oligodendroglia), interspersed with cytoplasmic

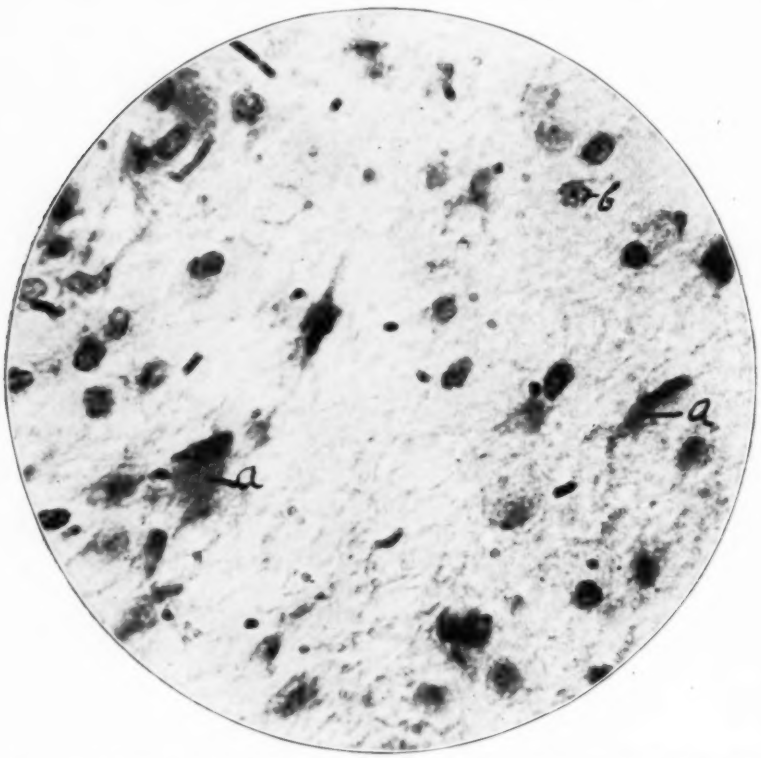

Fig. 2.—Midcervical region. The cells are glia elements; *a*, cytoplasmic glia; *b*, glia nuclei (oligodendroglia). Toluidine blue stain; × 800.

glia (fig. 2). The blood vessels were moderately hyperemic, and the capillaries were prominent. Perivascular infiltration was not noted in this area.

In the midcervical region, the gray matter was much better preserved. Many of the ganglion cells exhibited a sharp, regular outline with the usual arrangement of the Nissl bodies, the nucleus centrally located and the processes well preserved. In the dorsolateral group, a few large ganglion cells appeared as mulberry bodies (fig. 3). The glia elements showed the same increase as in the lower cervical region, but the cytoplasmic glia cells were here generally larger,

and their nuclei showed, in many instances, a more distinct chromatin reticulum and a well defined nucleolus.

Another feature in which gray matter of the midcervical region differed from that of the other segments was the relatively intense perivascular infiltration. Figure 4 shows the infiltrated walls of three blood vessels which lay in close proximity to each other, giving the impression of a rather strong vascular reaction. The infiltrating cells were predominantly lymphocytes. Plasma or polymorphonuclear cells were not found.

Practically the entire white substance below the upper dorsal region was converted into a continuous area of softening. The softened tissue was made

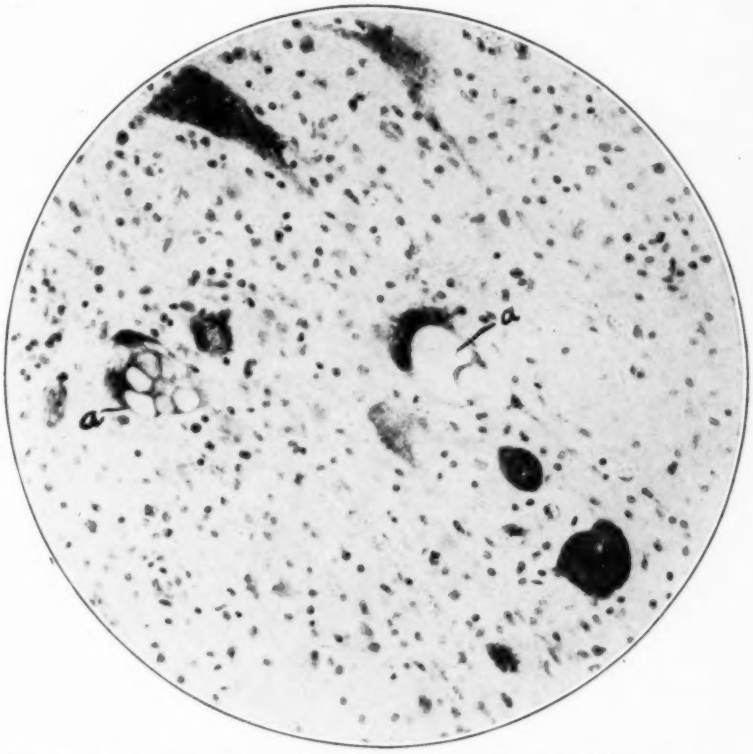

Fig. 3.—Anterior horn of midcervical region. Some ganglion cells are well preserved (in the left upper corner); some are badly damaged showing as "mulberry bodies" (*a. a.*). Toluidine blue stain; × 220.

up of numerous myelophages and various types of gitter cells. The myelophages appeared as greatly distended vacuolated cell bodies with a well stained nucleus located at the periphery. Many of the vacuoles contained remnants of broken up axis cylinders and fragments of myelin. The gitter cells represented, for the most part, the types which Jakob[10] characterized as α, β and γ cells. In

10. Jakob, A.: Ueber die feinere Histologie der sekundären Faserdegeneration in der weissen Substanz des Rückenmarks, mit besonderer Berücksichtigung der Abbauvorgänge, Histol. u. histopath. Arb. ü. die Grosshirnrinde **5**:1, 1913.

the α type, aside from the large vacuoles harboring nerve fibers, were small vacuoles enclosing lipoids. In the β and γ types, no remnant of fiber tissue was present but fat only was seen. In the γ cells the cell body was filled with a network of small vacuoles which, because of their regular arrangements and equal size, gave the cell a honeycombed appearance. While the myelophages, α and β cells lay in the softened tissue, the γ cells, in many instances, were found massed in the adventitial sheaths of the blood vessels. The adventitia of the latter could be seen broken up into several layers of concentric connective tissue strands which provided an envelope for each gitter cell (fig. 5). In this manner, the adventitia became densely packed with gitter (γ) cells.

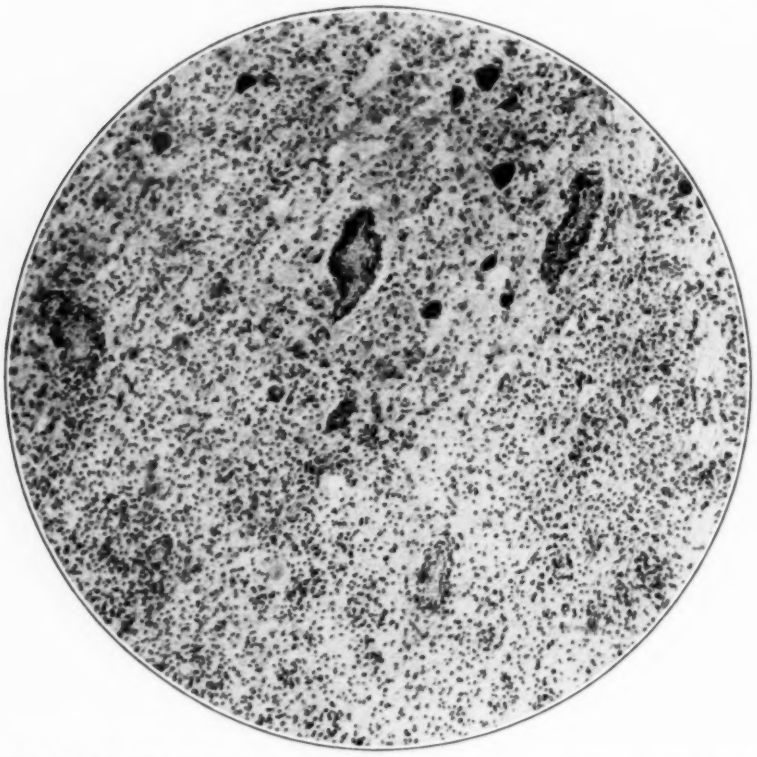

Fig. 4.—Midcervical region, anterior horn. The blood vessels show marked perivascular infiltration. The black bodies in the upper part of the picture are ganglion cells. The numerous dots, covering the field, are glia nuclei. Toluidine blue stain; × 80.

The white substance of the cervical region, which was the least damaged, contained areas of rarefaction or so-called "Lueckenfelder" (Schmaus,[11] Spiegel[12]). These "Lueckenfelder" represented small cavities separated from one

11. Schmaus, H.: Ueber sogenannte "Lichtungsbezirke" im Zentralnervensystem, München. med. Wchnschr. **52**:545 (March 21) 1905.

12. Spiegel, E.: Myelitis nach Grippe, Wien. klin. Wchnschr. **32**:258 (March 6) 1919.

another by thin septums. Their lumen was usually empty, but occasionally they harbored a naked axis cylinder or a fragment of myelin. Some of them contained gitter cells or myelophages.

The central canal was preserved only in the upper dorsal and cervical regions. Here it showed a conspicuous hyperplasia of the ependymal cells which, in some segments, were four or five rows thick. In many places the continuity of the ependymal wall was disrupted. When it was preserved the cells showed the normal cylindric shape; when the ependymal lining was disrupted they assumed a cuboid shape. In the cylindric cells both cytoplasm and chromatin reticulum were well defined, while in the cuboid cells the cytoplasm was scant and the

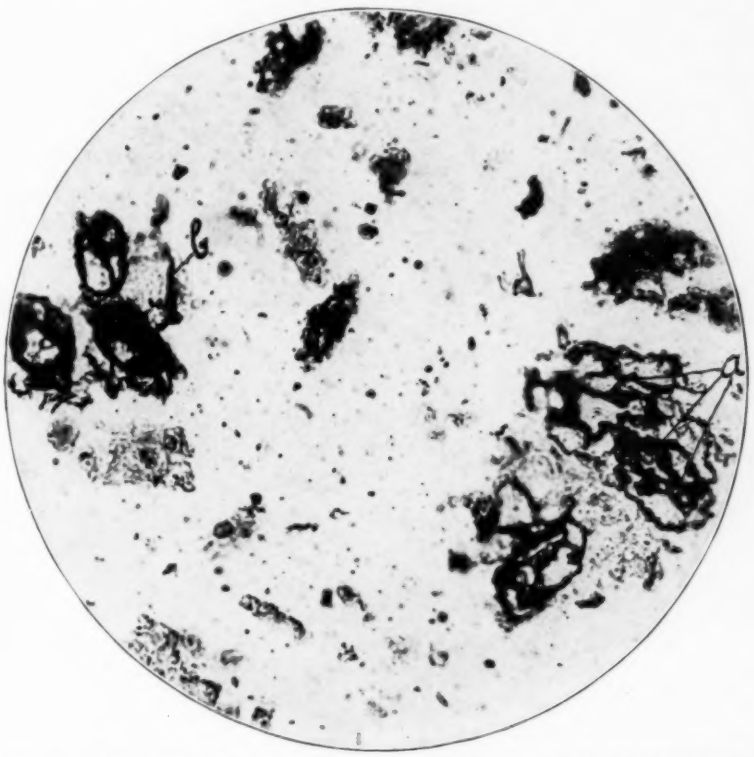

Fig. 5.—Upper dorsal region. The network of black strands are blood vessels; some (at *a*) show an enormous proliferation of the adventitia—black lines forming loops; each loop contains a gitter cell—a white reticulated body. At *b* can be seen processes enveloping gitter cells. Bielschowsky stain; × 800.

chromatin reticulum of the nuclei indistinct. The latter formed irregular masses, which were scattered in the tissue around the central canal and gave a picture of irregularly shaped nodules. Many ependymal cells, isolated or in groups, were also found within the lumen of the canal in which, especially in the cervical region, gitter cells were present, sometimes in large numbers (fig. 6). The gitter cells either lay free or were embedded in a fine network of fibers.

Roots and Peripheral Nerves: The roots were generally well preserved throughout. Of the peripheral nerves, the tibial and peroneal were examined,

and definite changes were not found in the myelin sheaths and axis cylinders. The endoneurium and perineurium contained foci of mild perivascular infiltration. The infiltrating cells consisted chiefly of lymphocytes and of oblong nuclei, some of which were rod shaped, some oval.

The pia-arachnoid was thickened throughout and considerably infiltrated. Among the infiltrating cells were numerous lymphocytes and polyblasts. The arterial walls were moderately hypertrophied and the lumens of both arteries and veins dilated. Perivascular infiltration was not noted nor were gitter cells found.

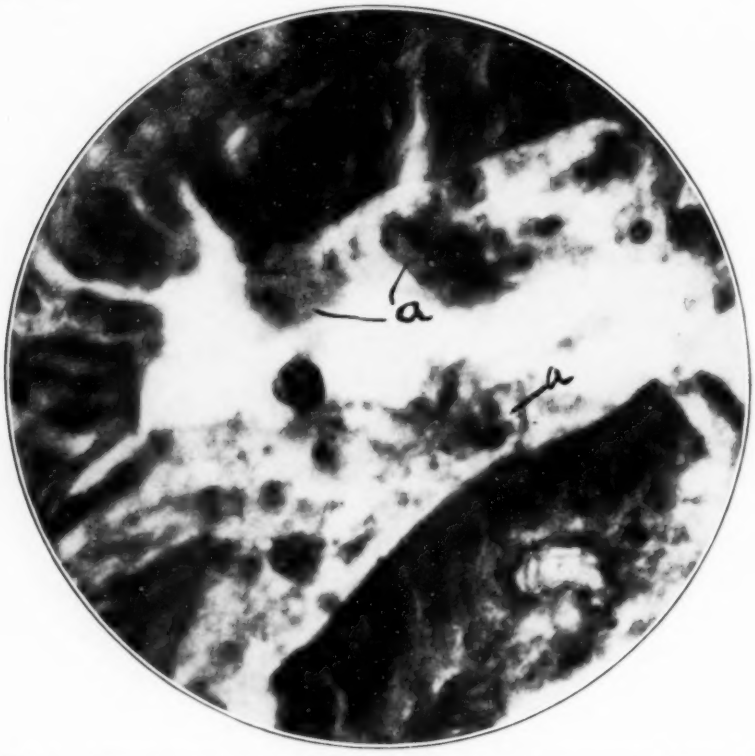

Fig. 6.—Central canal surrounded by proliferated and hypertrophied ependymal cells; some of the contents of the canal are gitter cells (*a*). Alzheimer-Mann stain; × 800.

In the medulla, the ganglion cells showed a marked increase in pigment, a mild degree of satellitosis and some neuronophagia. The capillaries and glia cells were greatly increased in number. The nuclei of the cranial nerves were practically intact. In the pons and in the cortex, the changes were slight and were confined chiefly to a mild satellitosis and a slight increase in the capillaries. In the cerebellum, some of the Purkinje cells appeared pale, but the majority of the cells were well preserved.

The choroid plexus showed marked hyperplasia. The number of the tuft cell layers was increased and the cells were swollen. The blood vessels were congested.

SUMMARY AND COMMENT

The condition in this case was mainly degenerative. However, scattered inflammatory phenomena were also present, as evidenced by the perivascular infiltrations. The degenerative changes much resembled those seen in cases of myelomalacia caused by thrombosis of the spinal blood vessels. No evidence of thrombosis, however, was found in this case; nor could the nature of the infection be determined. Bacteriologic examinations always gave negative results, while the gram-positive streptococci, isolated from the spinal cord at necropsy, could not be considered with certainty as the actual cause of the infection. In favor of the latter is the history of an induced abortion which was most likely responsible not only for the inflammatory but for the degenerative phenomena. If one assumes the cause to be an infection, then one has to determine the mode of invasion. Marinesco and Oettinger [6] first called attention to the central canal as the main avenue, Harbitz and Scheel [13] held that the cord is affected from the meninges, while Smirnow [14] and Pussep [15] insisted that the initial lesion must be looked for both in the central canal and in the meninges. According to their views, the virus travels first along the ependyma and the pia-arachnoid and spreads from these tissues toward the parenchyma. The bases for their conclusions were the proliferative and partly infiltrative changes which they found in and around the meningeal and ependymal tissues. Such changes, however, in the case here recorded were combined with the presence of numerous gitter cells within the central canal (fig. 6) and in the subarachnoid space (fig. 7). It is obvious that the gitter cells landed there from the parenchyma of the spinal cord, which is contrary to the conclusions of the authors mentioned. In other words, this case shows that the process of removal of the waste material is centrifugal, i.e., from the parenchyma toward both the central canal and the subarachnoid space as has been advocated by Hassin.[16]

In the subarachnoid space of the cerebral meninges, as well as in the ventricles, gitter cells were not found; this is in full accord with the fact that the parenchyma of the brain was free from any appreciable degenerative phenomena.

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13. Harbitz and Scheel: Pathologische Anatomie Untersuchungen über akute Poliomyelitis, Christiania, J. Dybwad., 1907.

14. Smirnow, L. J.: Die pathologische Anatomie und Pathogenese der Paralysis ascendens acuta, Arch. f. Psychiat. **78**:584, 1926.

15. Pussep, L.: Akute aufsteigende Myelitis als Komplikation der Influenza, Ztschr. f. d. ges. Neurol. u. Psychiat. **87**:377, 1923.

16. Hassin, G. B.: Effect of Organic Brain and Spinal Cord Changes on Subarachnoid Space, Choroid Plexus and Cerebrospinal Fluid, Arch. Neurol. & Psychiat. **14**:468 (Oct.) 1925; Notes on the Nature and Origin of the Cerebrospinal Fluid, J. Nerv. & Ment. Dis. **59**:113, 1924.

The case cited also afforded an opportunity for studying the reactive phenomena in the spinal cord. In general they were similar to those produced experimentally by Jakob [10] and those described in human pathologic changes by Hassin.[17] They illustrate the various stages of nerve degeneration and the mode of discharge of the degenerated tissue from the nervous system. The broken up nerve fibers are taken up by various gliogenous formations (myeloclasts and myelophages) and

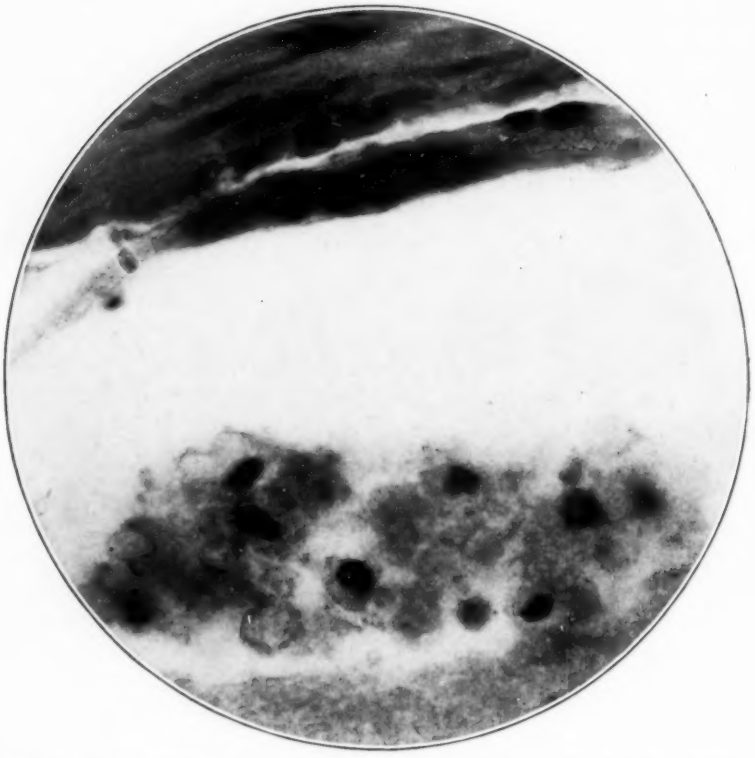

Fig. 7.—Middorsal region, showing numerous gitter cells (at the bottom of the picture) in the subarachnoid space. Van Gieson stain; × 850.

are transformed into lipoids for final elimination by the gitter cells. The gitter cells are carried to the adventitial spaces of the blood vessels and thence to the subarachnoid space.

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17. Hassin, G. B.: Histopathologic Findings in Two Cases of Subacute (Combined) Cord Degeneration, M. Rec. **91**:885 (May 26) 1917; Histopathologic Changes in a Case of Amyotrophic Lateral Sclerosis, M. Rec. **91**:228 (Feb. 10) 1917; Studies in the Pathogenesis of Multiple Sclerosis, Arch. Neurol. & Psychiat. **7**:589 (May) 1922.

As might be expected, the higher cervical segments exhibited changes of comparatively recent origin and therefore of a relatively mild nature. In the upper cervical areas the most conspicuous features were signs of a beginning secondary degeneration with reactive glia phenomena in the form of cytoplasmic glia and of numerous glia nuclei. So-called microglia cells of Hortega were not brought out in spite of repeated efforts. In the lower segments, in which the reactive glia changes reached their maximum, the parenchyma was almost entirely replaced by gitter cells and blood vessels, which contained them in their adventitial spaces. In other words, the nerve fibers were represented by lipoids enclosed within gitter cells. When the gitter cells were massed around the blood vessels, the adventitia could be seen to split up into numerous strands which projected as thin processes and enveloped the gitter cells. Hassin [18] and, more recently, Schaltenbrand [19] have described this process of removal of gitter cells in detail. It must be assumed that the presence of gitter cells in the adventitial spaces is due to an active enveloping process on the part of the adventitial membrane, while their presence in the subarachnoid space is the result of their transportation from the adventitial spaces which are in communication with the subarachnoid space.

As to the origin of the gitter cells, the sections studied could not provide definite information. The Hortega school consider them as mesodermal structures originating from the so-called microglia cells. In my sections, however, stained by the Hortega method, I was unable to find microglia cells. The nuclear staining methods showed rod cells scattered between the naked glia nuclei and the cytoplasmic glia in the cervical region. These rod cells are considered as the equivalent of the microglia. Their number was out of proportion, however, to the number of gitter cells which are supposed to originate from them. On the other hand, the glia cells could be traced in successive stages of transformation from cytoplasmic glia to more complicated structures. Obviously, these cytoplasmic glia cells play an important rôle in the so-called "Abbau" activity, a rôle assigned by Hortega and his pupils to the mesodermal elements (microglia) exclusively.

The changes found in the peripheral nerves must be considered as a moderate degree of interstitial neuritis. They were most likely responsible for the initial picture of multiple neuritis or a lesion of the cauda equina.

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18. Bassoe, P., and Hassin, G. B.: Myelitis and Myelomalacia, Arch. Neurol. & Psychiat. **6**:32 (July) 1921.

19. Schaltenbrand, G.: Encephalitis Periaxialis Diffusa (Schilder), Arch. Neurol. & Psychiat. **18**:944 (Dec.) 1927.

CONCLUSIONS

1. Myelomalacia may give the picture of Landry's paralysis.

2. In the case presented, the spinal cord showed various stages of acute central nerve degeneration with reactive phenomena in the glia, blood vessels, meninges and central canal.

3. Typical microglia cells were not found in the spinal cord. Their activity in removing the waste from the destroyed areas could not be demonstrated; such a function, at least in the spinal cord, is to be ascribed to the classic glia.

4. The condition found in this case corroborates the view that the spinal canal, like the subarachnoid space, is the recipient of the waste resulting from degeneration of the spinal cord parenchyma.

5. The adventitia of the capillaries takes an active part in the process of eliminating the gitter cells by means of thin processes which project and envelop the cells.

INTRACRANIAL ANEURYSMS*

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NEW YORK

Recently, I reported a case in which four macroscopic aneurysms of the intracranial arteries were an incidental postmortem observation in a woman dying from uremia. While the aneurysms were large and were situated at the base of the brain, cerebral symptoms which could be related to them were not demonstrated. Because of a four plus Wassermann reaction of the spinal fluid, and because of the type of the cellular reaction seen microscopically in the wall of the aneurysms, they were interpreted in this case as being the result of syphilitic arterial disease. In a rather extensive review of the literature, multiple intracranial aneurysms of syphilitic origin appear to be extremely rare.

Since the report of this first case, two other patients with macroscopic intracranial aneurysms have come to autopsy at St. Luke's Hospital. Each patient died as the result of rupture of the aneurysm, and each case represents a different etiologic factor in aneurysm formation. Both patients are from the medical service of Dr. Samuel W. Lambert to whom I am indebted for permission to use the clinical histories.

REPORT OF CASES

CASE 1.—I. L., a white woman, married, aged 30, was admitted to the hospital on Jan. 19, 1928. She was unconscious on admission, and only a short history could be obtained from friends. She was taken ill on the evening before admission, with headache, nausea, vomiting and drowsiness. She was seen by a physician, who, finding sugar in the urine and believing that she was in diabetic coma, gave her 30 units of insulin. The coma deepened and the patient was removed to the hospital the following morning. It is said that the patient had had considerable trouble with the eyes and with headache for the previous year. Other details of her past history were not obtained.

Examination.—Physical examination showed a well developed white woman, aged 30, lying unconscious in bed. She could not be roused by the prick of a pin. The right pupil was larger than the left and was slightly irregular. Both were fixed to light. Ophthalmoscopic examination showed two retinal hemorrhages in the left eye to the temporal side of the disk. The right fundus showed only congestion of the vessels. Examination of the lungs showed an area of dulness, with crepitant râles and increased breath sounds, at the left base near the vertebral column. Lesions were not observed in the heart. The abdominal, ankle and knee reflexes were absent on both sides. The legs were flaccid. Babinski and Gordon reflexes were absent. The temperature on admission was 102 F. The pulse rate ranged from 130 to 150 per minute. The blood pressure was 110 systolic and 60 diastolic. Examination of the blood showed: hemoglobin, 110 per cent; red cells,

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* From the Pathological Laboratory, St. Luke's Hospital.

5,000,000; white cells, 20,000; polymorphonuclears, 83 per cent; lymphocytes, 15 per cent, and large mononuclears 2 per cent. The urea nitrogen of the blood was 14 mg. per hundred cubic centimeters. The blood sugar was 150 mg. per hundred cubic centimeters, and the carbon dioxide 51 per cent by volume. The Wassermann reaction of the blood was negative. Lumbar puncture was done and 15 cc. of bloody fluid was removed under normal pressure. Examination showed 14 lymphocytes and many red blood cells per cubic millimeter. The globulin reaction was four plus and the Wassermann reaction was negative.

Course.—The patient remained unconscious, was cyanotic and failed to react to the ordinary stimulating drugs. She died five hours after admission and seventeen hours after the onset of the symptoms.

Postmortem Observations.—Autopsy was performed in the afternoon of the day of death. Only the essential observations will be given. The thymus was per-

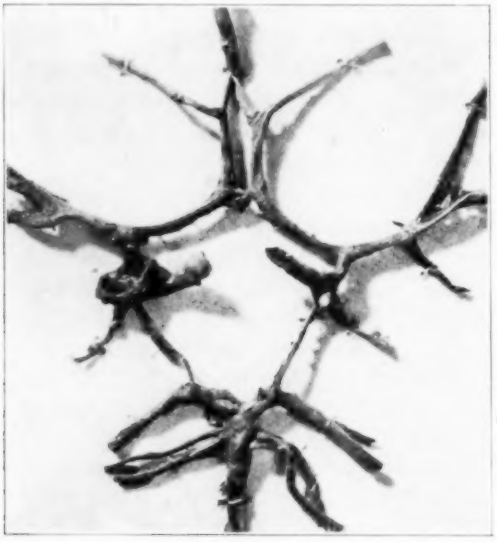

Fig. 1 (case 1).—The dissected arteries of the circle of Willis showing the ruptured aneurysm at the junction of the right middle cerebral and right posterior communicating arteries.

sistent, the two lobes measuring 7 by 2 by 1.5 cm. and 7 by 4 by 1.5 cm. They were connected by an isthmus. Lesions were not noted in the heart. In the lower portion of the upper lobe of the left lung was an edematous, hemorrhagic, firm area, section of which showed numerous, irregular areas of grayish-white consolidation. The abdomen showed no pathologic changes.

Examination of the head did not reveal any evidence of injury. Lesions were not observed in the scalp, temporal muscles and calvarium. Beneath the dura mater on the right side was a massive blood clot, measuring 14 by 10 cm., which extended over the right temporal lobe. This clot extended beneath the temporal lobe into the right middle fossa. It surrounded the stalk of the pituitary gland and the optic chiasm and extended a short way into the left middle fossa. On the inferior surface of the right temporal lobe was an area of softening, 4 by 4 cm., which extended into the substance of the brain and connected with the right ventricle

This area contained softened brain and old blood clot. The pia-arachnoid covering it was thin and easily torn. Extending mesially, just beneath the cortex, was a dissecting tract filled with clot. This pierced the pia-arachnoid at a point near the right internal carotid artery. At the junction of the right middle cerebral and right posterior communicating arteries was a thin-walled saccular aneurysm, measuring 0.7 by 0.5 by 0.4 cm. The inferior wall was missing. The sac contained fresh blood clot, but no evidence of an old laminated clot was seen. The other intracranial arteries were thin-walled and did not show any pathologic changes. Cross-section of the brain did not reveal any lesions except the traumatic softening in the right temporal lobe.

Microscopic examination of the organs removed did not show any essential lesions with the exception of a rather early bronchopneumonia in the left lung. The wall of the aneurysm was not sectioned.

Case 2.—W. J. H., a white man, aged about 60, was admitted to the hospital on April 17, 1928. He was a porter in St. Luke's Hospital and came to the examining room about 10 p. m., because he felt "queer" and could not sleep. He had worked during the day and considered himself in perfect health. He had never been troubled with insomnia and considered his present inability to sleep as being abnormal. The examining physician was called; before he arrived the patient had become unconscious. He was given 12 minims (0.74 cc.) of epinephrine and was admitted to the medical ward.

Examination.—Physical examination showed a well developed and well nourished white man. He was unconscious and had labored respirations with prolongation of expiration. The face, extremities and skin of the body were cyanotic. There was a slight external strabismus of the left eye. The pupils were small, equal and regular, and did not react to light. The tongue lay in the right side of the mouth. The lungs showed dulness and many moist râles at the right base posteriorly. The heart was enlarged, the left border of dulness being in the fifth interspace, 11.5 cm. from the midsternal line. The rate was rapid and the rhythm irregular. Murmurs were not heard. The radial, temporal and brachial arteries were tortuous and ropelike. The blood pressure was 230 systolic and 120 diastolic. The knee and ankle reflexes were not obtained. The deep reflexes of the right arm were more active than were those of the left. The sphincter control was normal. Ophthalmoscopic examination showed the veins of both eyes to be distended. The arteries were sclerotic. In the right eye, just above and to the nasal side of the disk, was one rather large, pear-shaped hemorrhage. The temperature ranged from 101 to 104 F. The pulse rate averaged 140 per minute, and the respirations fluctuated from 26 to 48 per minute. Examination of the blood showed: hemoglobin, 107 per cent; red cells, 4,800,000; white cells, 14,800; polymorphonuclears, 70 per cent; lymphocytes, 26 per cent, and eosinophils, 4 per cent. The urea nitrogen of the blood was 27.7 mg. per hundred cubic centimeters. The blood sugar was 125 mg. per hundred cubic centimeters, and the carbon dioxide, 55 per cent by volume.

Course.—The patient was given digitalis and caffeine intravenously, and 450 cc. of blood was removed by phlebotomy. He did not regain consciousness, and died forty-eight hours after admission.

Postmortem Observations.—Autopsy was performed three days after death. Only the essential observations will be given.

The lungs were edematous, and toward the bases there were small mottled areas of bronchopneumonia. The heart was greatly enlarged and weighed 675 Gm.

The muscle of the left ventricle was coarse, hypertrophied and measured about 2.5 cm. in thickness. In the muscle near the apex there were several white scars. The mitral valves were moderately thickened, but there was not any evidence of inflammation. The aortic leaflets were fibrous and thickened. On the two anterior aortic leaflets were several raised, nodular pinkish-gray friable vegetations, the largest of which was 0.4 cm. in diameter. The sinuses of Valsalva were greatly deepened, but the lining epithelium was smooth. Throughout the coronary arteries showed numerous, irregular, raised, yellowish atheromatous plaques which were without calcification. Lesions were not noted on the right side of the heart and in the tricuspid and pulmonic valves.

The spleen was enlarged, fibrous and showed a soft pulp. Toward the upper pole there were three small yellowish infarcted areas surrounded by a zone of hemorrhage.

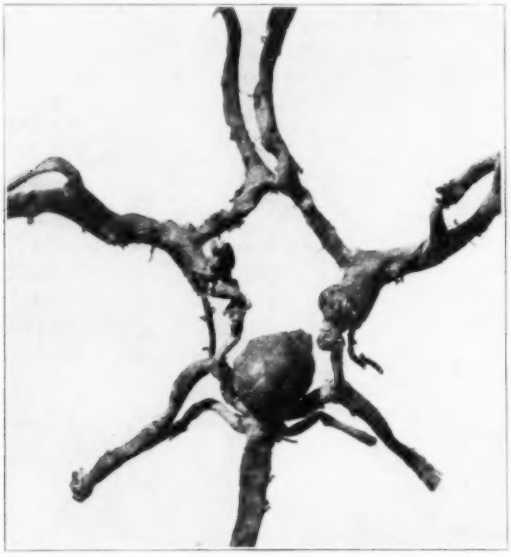

Fig. 2 (case 2).—The dissected arteries of the circle of Willis showing the ruptured aneurysm of the basilar artery.

The kidneys were of normal size and showed granular cortices and an increase in the peripelvic fat.

The aorta showed numerous irregular atheromatous plaques, without ulceration or calcification.

Lesions were not observed in the scalp and calvarium. The dura mater was everywhere intact. Beneath the pia-arachnoid, over the entire surface of the brain but most marked in the sulci, was a large amount of hemolyzed blood and a small amount of blood clot. At the base of the brain, surrounding the optic chiasm and the pituitary stalk, was a large amount of fresh blood clot. Protruding from the forward end of the basilar artery, anterior to the posterior cerebral arteries, was a saccular aneurysm, measuring 1.1 by 1 by 1 cm. At the tip was a small, curved, ragged laceration which measured 0.2 cm. in length. The wall of the aneurysm was thin, bluish and did not show sclerotic patches. The sac was completely covered by old pinkish blood clot. The contents were fresh blood

clot which did not show evidence of lamination. No embolus was found. The other intracranial arteries showed moderately thickened walls without circumscribed areas of sclerosis.

Sections of the brain showed normal gray and white matter, without evidence of old or fresh hemorrhages. Both lateral ventricles, as well as the third and fourth ventricles and the cisterna magna, were filled with a large amount of blood clot. The medulla and pons did not show any lesions.

Microscopic examination of the organs was unsatisfactory because of the extensive postmortem degeneration. The heart showed hypertrophied muscle fibers, separated in places by small connective tissue scars. The lungs were edematous and many alveoli were filled with albuminous exudate. Many bronchi were filled with polymorphonuclear leukocytes, as were the surrounding alveoli. A few of the smaller vessels contained hyaline thrombi.

The kidneys showed small wedges of connective tissue growing in from the periphery, replacing the normal glomeruli and tubules. These areas contained many round cells. The interstitial connective tissue of the medulla was also increased in amount. The sinusoids of the liver were congested, and there was a central lobular atrophy of the liver cells, with a small amount of bile stasis.

The aorta showed a moderately thickened intima. The media was thickened and showed considerable hyaline and myxomatous degeneration. There was no cellular infiltration.

Sections of the cerebrum and cerebellum did not show any lesions with the exception of the hemorrhage beneath the meninges. The wall of the aneurysm was not sectioned, because the specimen was desired as a permanent one for the museum.

COMMENT

From the standpoint of gross anatomy and pathology, these cases are interesting as they undoubtedly represent two distinct and separate conditions as the bases for the development of aneurysms. In case 1 the aneurysms was found in a woman, aged 30, who did not show any evidence of syphilis, arteriosclerosis or bacterial endocarditis. The absence of these diseases of the cardiovascular system, the youthfulness of the patient, and the situation of the aneurysm at the point of bifurcation of an artery, which according to Eppinger is a weak point anatomically and one at which aneurysms are apt to develop, force one to class this aneurysm as one of congenital origin.

The case of the second patient is entirely different. He was older and showed gross evidence of extensive sclerosis of the peripheral arteries, aorta, coronary and intracranial vessels. He also showed a terminal acute bacterial endocarditis of the aortic valve. In spite of the definite evidences of generalized arteriosclerosis, it is in this type of case, which shows also an acute bacterial endocarditis, that the development of aneurysms has been ascribed to septic emboli from the heart. While this possibility cannot be denied, I see nothing in this case to substantiate such a theory. Surely the aneurysmal formation can more easily be accounted for on the grounds of the generalized arteriosclerosis, which is known to exist.

From the standpoint of diagnosis, these cases are interesting and instructive. Each patient died as the result of intracranial hemorrhage, and in each this was the clinical diagnosis. However, neither gave the typical acute history of the ordinary cerebral accident. The gradual onset of unconsciousness, associated with headache, dizziness, nausea and vomiting, suggest a more progressive and less destructive involvement of the central nervous system. The irregularity of the pupils in the first patient, and the strabismus of one eye in the second, in the absence of other more definite neurologic signs, suggest a primary disturbance at the base of the brain. Neither patient complained of something "snapping" at the base of the skull and neither complained of pain low in the back of the neck. These two symptoms have often been described as occurring in patients with ruptured aneurysms at the base of the brain.

A bloody spinal fluid was obtained in the one patient in whom a lumbar puncture was done. The only significance to be attached to this observation is that a hemorrhage of sufficient size and exact location had occurred which allowed the escape of blood into the subarachnoid space. This is always the rule in ruptured intracranial aneurysms, and is occasionally seen in cortical hemorrhages which involve the substance of the brain or the ventricles.

SUMMARY

Two additional cases of ruptured aneurysm are reported. One aneurysm is probably of congenital origin, while the other is best considered as being of the arteriosclerotic type. Each patient died as the result of intracranial hemorrhage, and in each the gradual and progressive character of the cerebral symptoms, combined with evidence of irritation of the nerves at the base of the brain, were sufficient at least to suggest a clinical diagnosis of ruptured intracranial aneurysm.

EFFECT OF ALCOHOL ON THE PATELLAR TENDON REFLEX TIME *

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AND
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Previous studies [1] of reflex time in subjects with mental aberrations gave evidence that retardation and facilitation of the higher correlation centers, respectively, decrease and increase patellar tendon reflex time. In our studies we have designated reflex time as the time interval elapsing from the instant of stimulation of the tendon to the appearance of electrical changes in the executant muscle. These studies introduce the question of whether or not the reflex time might be experimentally varied by alterations of these higher correlation centers by drugs. The present report gives the results obtained by the administration of alcohol with that aim.

Previous investigators have determined the effect of alcohol on the extent of the knee jerk and on its latent time, as determined by gross movement of the extremity and by the thickening of the muscles involved. Dodge and Benedict [2] reported that moderate quantities of alcohol lessened the speed and amplitude of the movements of the knee reflex in healthy persons. These workers determined time and movement by the thickening of the quadriceps muscle. In repeating these experiments, Miles [3] found that the speed of the knee jerk was first lessened and later increased while the amplitude was irregularly affected throughout. In considering the movement of the foot, Tuttle [4] reported that alcohol may either decrease or increase the extent of the reflex. Electromyographic studies of this problem have not come to our attention. Since such studies provide a means of learning the earliest arrival of the nerve impulse at the muscle, they would appear to offer the truer measure of speed of nervous conduction.

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* Submitted for publication, May 31, 1928.

1. Travis, L. E.: Rate of Reflex Conduction in a Cataleptic Patient, Proc. Soc. Exper. Biol. & Med. **25**:598 (April) 1928.

2. Dodge, and Benedict: Psychological Effects of Alcohol, Washington, 1915.

3. Miles, W. R.: Effect of Alcohol on Psycho-Physiological Functions, Carnegie Inst., Washington Pub., 1918.

4. Tuttle, W. W.: The Effect of Alcohol on the Patellar Tendon Reflex, J. Pharm. & Exper. Therap. **23**:163 (April) 1924.

EXPERIMENTAL WORK

Apparatus and Method.—A detailed description of our apparatus has already appeared.[5] Briefly, it consists of a three stage, resistance coupled amplifier, a portable three element oscillograph, a vacuum tube oscillator and a signal circuit.

The amplifier furnishes medium amplification, and as determined by controlled tests is exceptionally free from inherent disturbances. The oscillograph is manufactured by the Westinghouse Electric and Manufacturing Company. A supersensitive element capable of responding within 1/20,000 of a second was used for recording the electrical changes in the muscle. A special photographic unit was devised to replace the one with which the oscillograph was equipped. This unit handles 400 feet of standard size moving picture film. The oscillator, a General Radio Company low frequency oscillator, type 377, was used to furnish a time line of 1,000 complete cycles a second. The signal circuit was actuated by discharging a condenser that had been charged previously.

The electrodes were thin brass strips, ½ by 3 inches (1.2 by 7.6 cm.). They were covered by canton flannel moistened with saturated salt solution. The first electrode was placed over the motor point of the executant muscle. According to Tuttle and MacEwen,[6] this point is located half way between the proximal margin of the patella and the anterior superior spine of the ilium. The second electrode was placed about ¼ inch (0.6 cm.) distal to the first. The subjects were comfortably seated with their thighs slightly elevated to put some tension on the quadriceps muscles. As a long series of unpublished experiments has established the fact that changes in rate and intensity of stimulation do not have any effect on reflex time, an attempt was not made to keep such factors constant.

Unlike previous investigators who studied the effects of relatively small exhibitions of alcohol on reflex time, we sought to minimize the activity of the higher radiational centers by producing stupor as quickly as was therapeutically advisable. Because of individual differences in height, weight and tolerance, we were forced to follow a slightly different management in the case of each person. In general, a subject was given orally, in concentrated form and with the greatest advisable speed, a quantity of absolute alcohol sufficient to result in his becoming partially unconscious.

Subjects.—Five graduate students of varying tolerance were selected to meet the following qualifications: physical fitness, good mental endowment and emotional stability. They were instructed several days before the experiment to avoid anything unusual in the way of activity, medication, spirits, diet and mental stress or strain. Although unfinished studies show that suggestion does not affect reflex time, an attempt was made to minimize this factor during each experiment.[7]

SUBJECT A.—A man, aged 26, weighing 150 pounds (68 Kg.), and 5 feet 9½ inches (176.5 cm.) tall, had been drinking a moderate amount once a month for the past seven or eight years. The last time this occurred was one week before the day of the experiment. He had never been deeply intoxicated before.

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5. Travis, L. E., and Hunter: The Relation Between Intelligence and Reflex Conduction Rate, J. Exper. Psychol. **11**:342 (Oct.) 1928.

6. Tuttle and MacEwen: A Method of Determining the Length of the Femoral Nerve and for Locating the Motor Point of the Rectus Femoris Muscle in the Intact Human Body, Anat. Rec. **37**:317 (Jan.) 1928.

7. It was feared that suggestion, in its effect on the higher correlation centers, might increase the resistance to the onset of stupor. A general discussion of the effects of alcohol on the human body is presented in: Alcohol, Its Action on the Human Organism, Medical Research Council, London, His Majesty's Stationery Office, 1923.

SUBJECT B.—A man, aged 24, weighing 160 pounds (72.6 Kg.) and 5 feet 11 inches (180 cm.) tall, had drunk inordinately twice a month for the past three years. His last drinking bout occurred one month before the day of the experiment.

SUBJECT C.—A man, aged 25, weighing 160 pounds and 5 feet 10 inches (178 cm.) tall, was deeply intoxicated once six years before the experiment. Since then, he had drunk moderately once every two or three months. He drank a small amount one week before the day of the experiment.

SUBJECT D.—A man, aged 32, weighing 160 pounds and 5 feet 10 inches tall, had drunk moderately once every two months for the past five years. His last drinking occurred two weeks before the day of the experiment.

SUBJECT E.—A man, aged 24, weighing 128 pounds (58.1 Kg.) and 5 feet 6 inches (167 cm.) tall had been moderately intoxicated but once, one year before the day of the experiment.

RESULTS

The accompanying graphs show the effect of alcohol on reflex time and on action current duration.[8] In the case of each subject, both of these variables were plotted as presented for the purpose of emphasizing the significant correspondence of the effect of alcohol on the two. In general, as the reflex time is decreased the action current duration is increased. This is indicated in the figures by having the reflex time and the action current duration read in opposite directions on the ordinate. The variations are constant in direction but irregular in extent. Each circle represents a knee jerk. The arrows, in turn, indicate the exact time of administration of alcohol, the duration of time when kicks could not be elicited and the lapse of time at rest periods.

In the case of subject A, as shown in figure 1, 60 cc. of alcohol sufficed to produce little observable change in reflex time but a noticeable variation in action current duration. Eight minutes after the ingestion of 30 cc. more of alcohol, marked variations in both variables occurred —as reflex time decreased action current duration increased (a situation seemingly analogous to an inverse relationship). Approximately forty minutes after the last intake of alcohol, there is a noticeable tendency for reflex time to approach its normal level, while action current duration is still irregularly increased. The last series of records shows that the reflex time became, and that the action current duration remained, slightly increased.

Subject B (fig. 2) shows the beginning of a noticeable change in both reflex time and action current duration shortly after the ingestion of a second 40 cc. of alcohol. At first, the reflex time is irregularly decreased and the action current duration irregularly increased. At the end of the series of jerks, the former is considerably longer than this

8. We have used the term action current duration to signify the interval of time between the first and last action current oscillation occurring in each knee jerk.

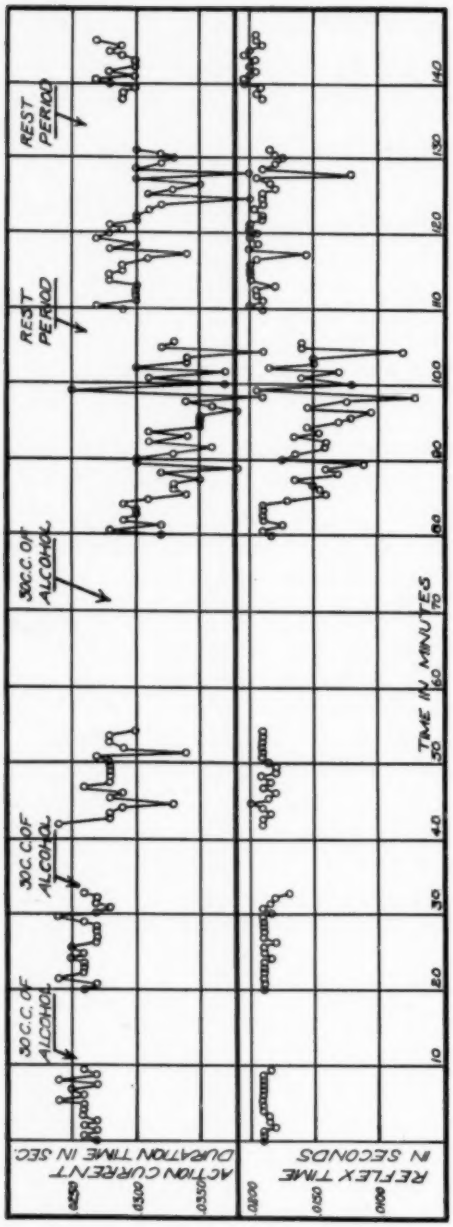

Fig. 1.—Reflex time and action current duration of subject A.

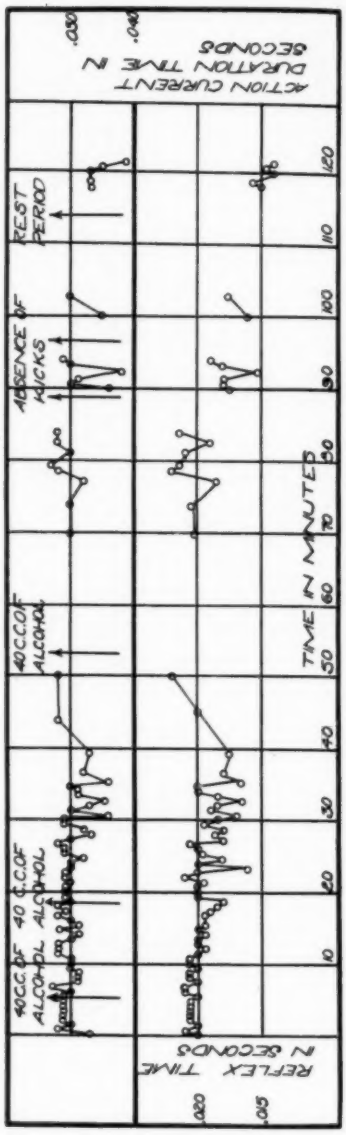

Fig. 2.—Reflex time and action current duration of subject B.

subject's normal time, and the latter is of normal length. Following the third dose of 40 cc. of alcohol and lasting until the end of the experiment, both reflex time and action current duration present changes which are constant in direction but irregular in extent.

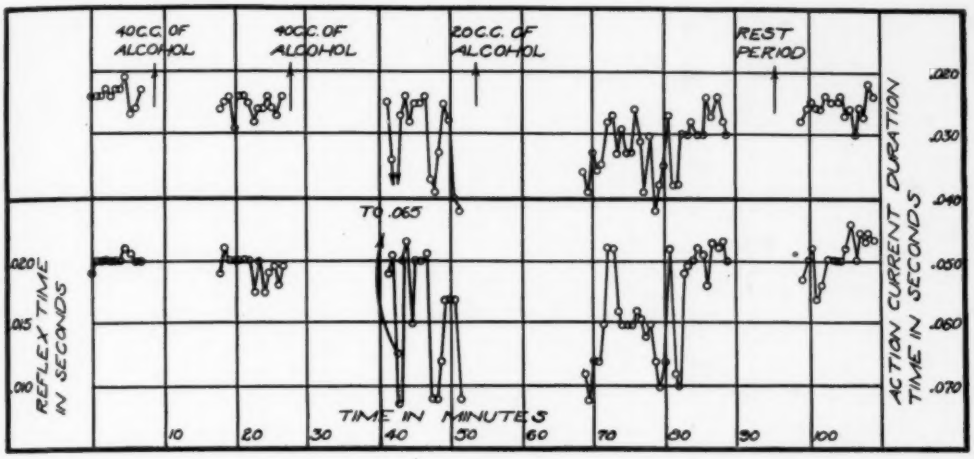

Fig. 3.—Reflex time and action current duration of subject C.

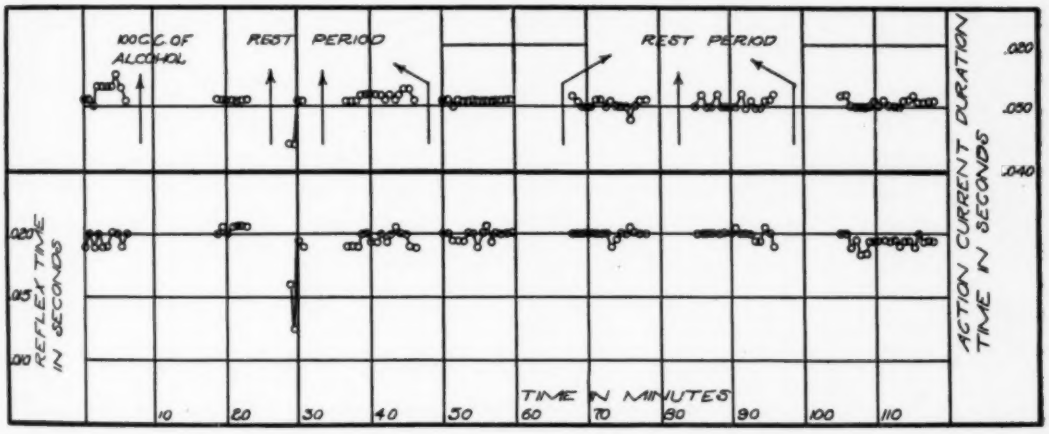

Fig. 4.—Reflex time and action current duration of subject D.

For subject C (fig. 3), fifteen minutes after the ingestion of a second 40 cc. of alcohol, both the reflex time and the action current duration were irregularly affected in constant directions—a decrease of the former and an increase of the latter. Fifteen minutes after the ingestion of 20 cc. more of alcohol, these irregular changes persisted with a tendency toward the end of the series for both factors to return to near normal

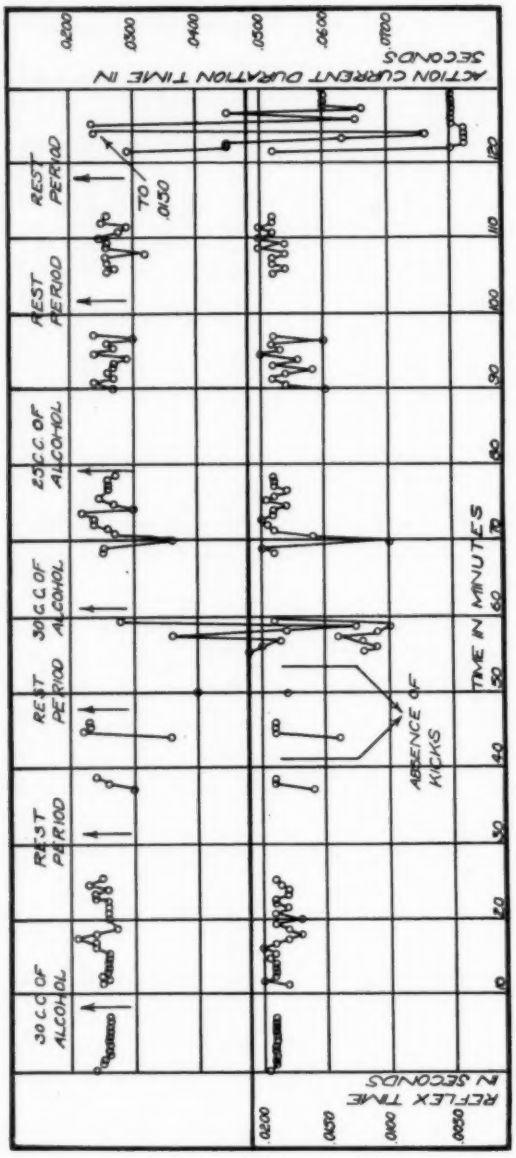

Fig. 5.—Reflex time and action current duration of subject E.

limits. Following a ten minute rest period, this tendency became more pronounced.

To subject D (fig. 4) was attributed at the beginning the strongest tolerance of the group. He was given an initial quantity of 100 cc. of alcohol which did not produce an observable change until twenty minutes after its ingestion. At this time, he became stuporous. Two of the four jerks elicited revealed reduced reflex time and increased action current duration. Shortly after this, the subject vomited a large quantity of fluid and was unable to retain more alcohol. He stated that his mind felt practically clear. Further knee jerks did not disclose remarkable changes. It was estimated that subject E (fig. 5) had the lowest tolerance of the group. Thirty cubic centimeters of alcohol was sufficient to produce noticeable changes in reflex time and action current duration. Additional doses of 30 cc. and 25 cc. of alcohol were followed by continued irregularity of results to the end of the experiment, when extremely marked alterations in both factors occurred. The single instance of coupled marked reduction of reflex time and action current duration was found here. The photographic records of the jerks presenting this relationship appear in figures 6 *B* and 6 *C*.

In addition to the conditions reported in the graphs, other noteworthy phenomena are to be seen in the original photographs. Figure 6 presents a series of records of subject E. Figure 6 *B*, besides showing greatly reduced reflex time and action current duration, is unusual in presenting two discrete diphasic waves of relatively high frequencies and of opposite directions. Figure 6 *C* presents the same features plus a third diphasic wave of small amplitude which occurs in a direction opposite that of the second large wave. In 6 *D* and 6 *E* the initial action current wave is of relatively low frequency and of reduced amplitude. Here discrete diphasic waves follow with much longer intervals of time between them than appeared between those of the two previous figures. Figure 7 presents records of subject C. Figure 7 *B* reveals the following entities: a reduced reflex time; an increased action current duration, and an unusually large initial action current wave. Figure 7 *C* shows a reduced reflex time and six diphasic waves appearing aperiodically in alternating directions. Figure 8 includes records of subject A. Figure 8 *B* shows a series of five diphasic waves appearing periodically in alternating directions. The first wave of the series is of small amplitude.

COMMENT

The present experiments would tend to confirm our initial impression (derived from a study of the effect of mental aberrations on reflex time) that a reduction in higher center activity is accompanied by freer and

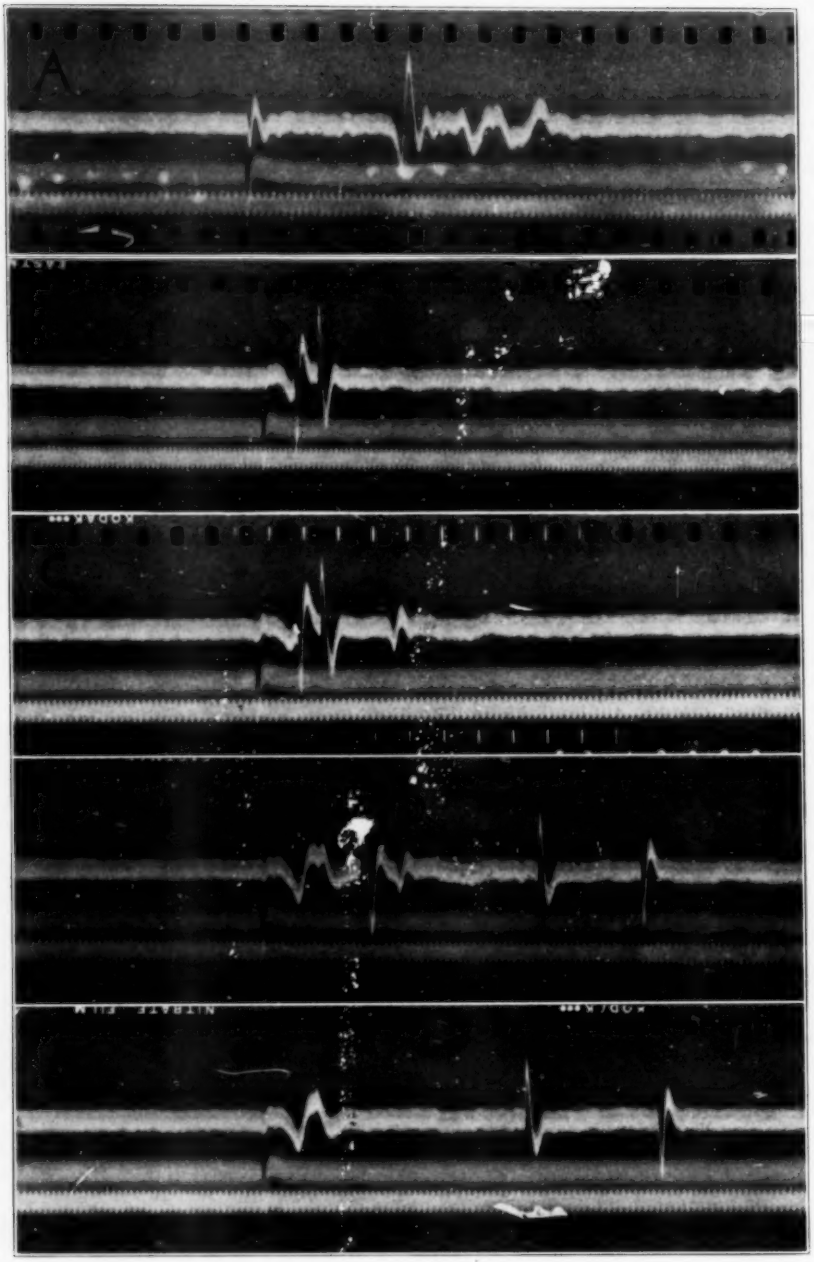

Fig. 6.—Photographic records from subject E. *A* was taken before the ingestion of alcohol; *B*, *C*, *D* and *E* were taken following the ingestion of the total quantity (85 cc.). Reading from above down in each record, the first line is the action current line, the second is the signal line and the third is the time line.

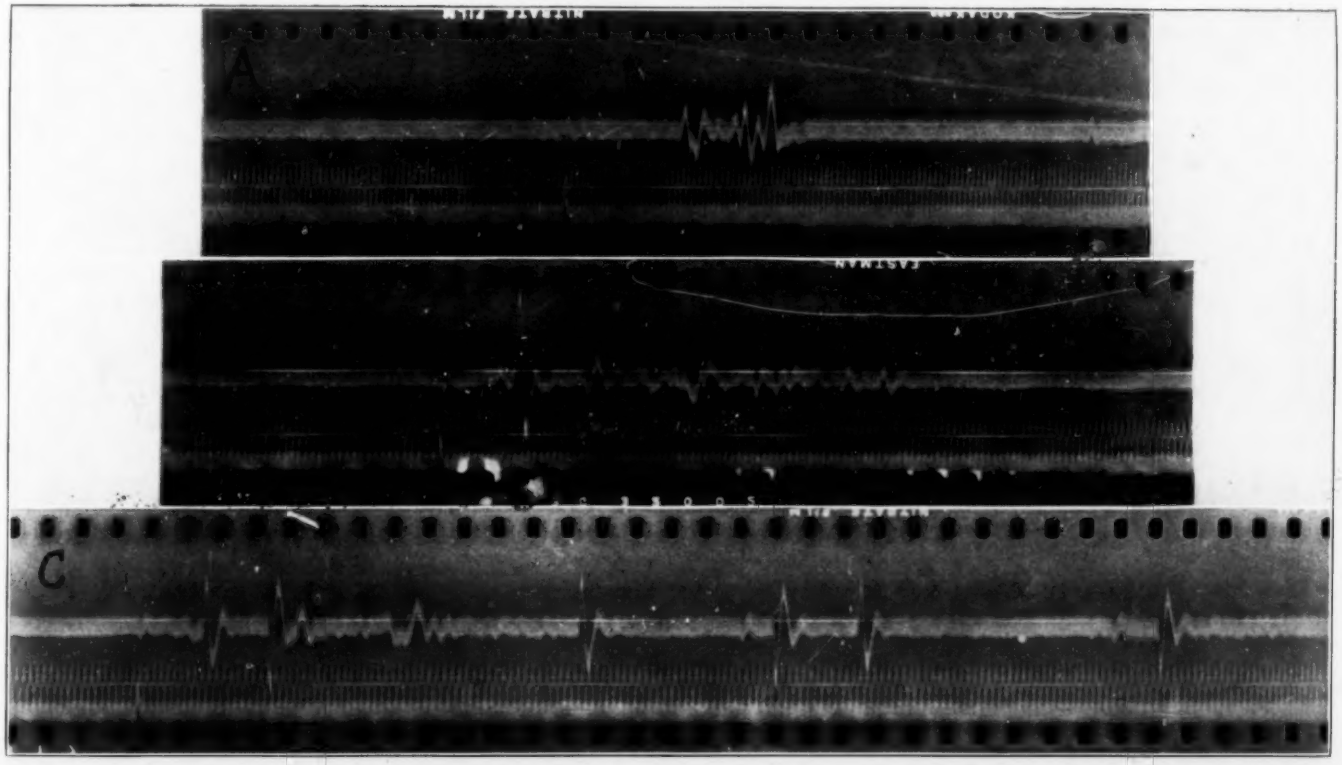

Fig. 7.—Photographic records from subject C. *A* was taken before the ingestion of alcohol. *B* and *C* were taken after the ingestion of the total quantity (100 cc.). Reading from above down in each record, the first line is the action current line, the second is the time line and the third is the signal line.

subsequently faster activity on the part of subjacent centers. Phylogeny intimates that the present complex nervous organization of man is a result of the pyramiding of more adequate biologic structures on less efficient ones. The latter are permitted to retain a measure of autonomy, but physiologically the tendency seems to be to make them dependent for their ultimate expression on their release by the more recently acquired structures. Theory has it that the superjacent structures exercise an inhibitory effect on their immediate dependencies. When the higher centers (superimposed levels) are unusually active, the lower centers express such activity by a depression of their own reactions. Again, when these higher centers are unusually inactive, the lower centers express the results of this eliminated influence by their overactivity; witness Setschenow's observations [9] of greatly depressed or even entirely inhibited spinal reflexes following stimulation of the exposed cut surface after decerebration in the frog, the spasticity resulting from lesions of the upper motor neurons, decreased reflex time in catatonic stupor and increased reflex time in maniacal states. The common anesthetics appear to act first on the more recently acquired structures and successively influence radiational centers of lower order. Alcohol seemingly has this progressive effect on the nervous system. Hence, when alcohol is administered in quantities sufficient to produce semistupor, as manifested by drowsiness and sluggish and incoherent ideation, the domination of the structures responsible for such behavior over their dependent structures may be said to be diminished. In our experiments, any such diminution was accompanied by a markedly reduced reflex time and a greatly increased action current duration. The probability that the alcohol depresses also the lower motor neuron is considerable (figs. 6 *D*, 6 *E*, 7 *C* and 8 *B* may be taken to indicate some effect on it), but owing to the greater involvement of the more influential higher levels such depressor effect is obscured.

In our treatment of this problem, we do not attempt to interpret further noteworthy items of this study resulting from alcoholic intoxication such as: the irregular nature of the decrease and increase of reflex time and action current duration respectively; the two discrete diphasic waves of relatively high frequency and of opposite directions (fig. 6 *B*); the initial action current wave of relatively low frequency and amplitude (figs. 6 *D* and 6 *E*); an unusually large initial action current wave (fig. 7 *B*), and discrete diphasic waves appearing both periodically and aperiodically in alternating directions (figs. 7 *C* and 8 *B*).

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9. Setschenow: Physiologische Studien über der Hemmungs Mechanismen für das Reflextätigkeit in Gehirn des Frosches, Berlin, 1863.

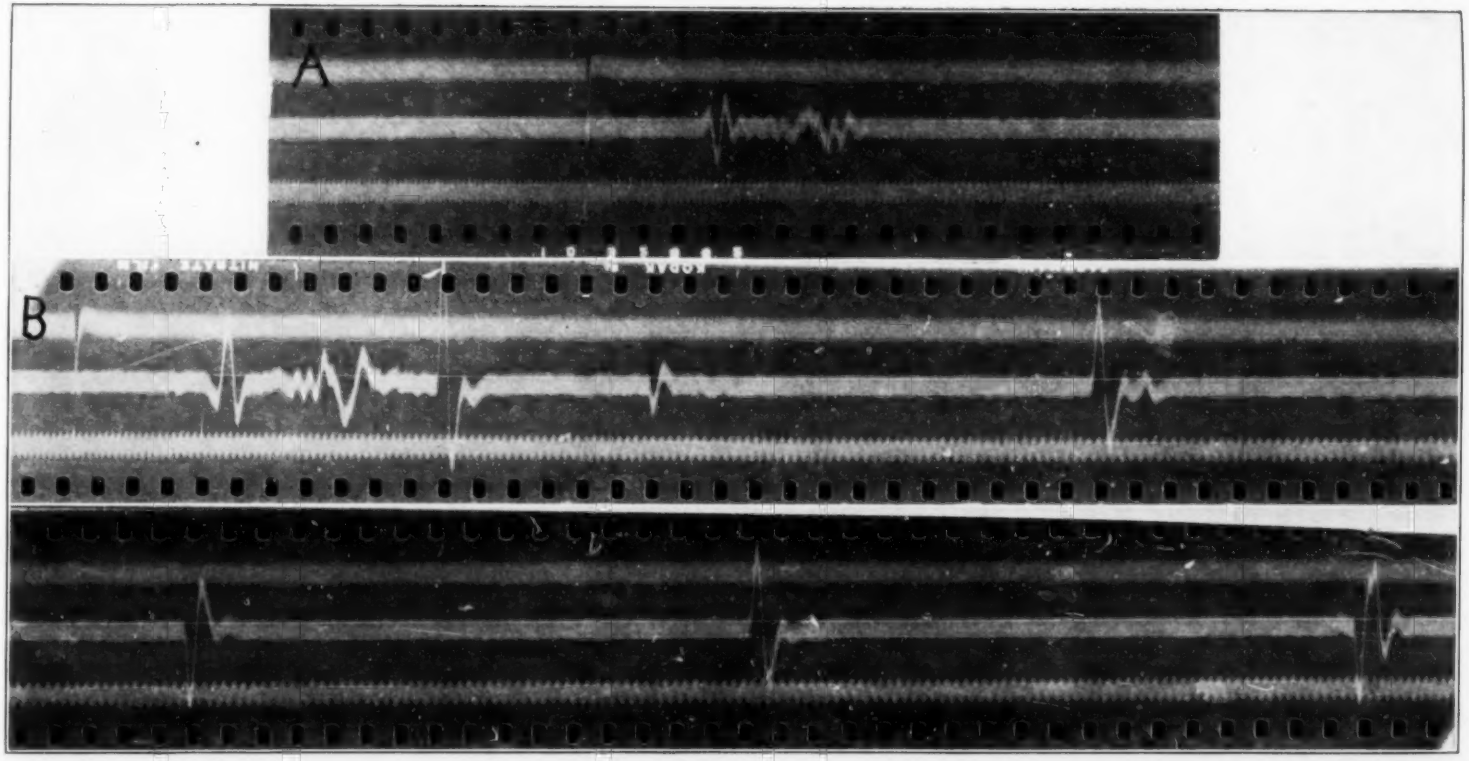

Fig. 8.—Photographic records from subject A. *A* was taken before the ingestion of alcohol. *B* was taken following the ingestion of the total quantity (90 cc.). Reading from above down in each record, the first line is the signal line, the second is the action-current line and the third is the time line.

SUMMARY

The following results were obtained in a study of patellar tendon reflex time just preceding, during and succeeding partial stupor resulting from alcoholic intoxication:

1. As stupor advanced, the reflex time progressively and irregularly decreased.

2. As stupor cleared up, the reflex time progressively and irregularly increased.

3. As stupor advanced, action current duration progressively and irregularly increased.

4. As stupor cleared up, action current duration progressively and irregularly decreased.

5. A significant correspondence of a nature analogous to that of an inverse relationship existed between variations in reflex time and action current duration.

6. Certain irregularities of the action current waves were obtained.

STUDIES IN EPILEPSY

VI. FACTORS AFFECTING CONVULSIONS INDUCED IN RABBITS *

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The mechanism by which certain drugs produce convulsions in normal animals presumably differs from the mechanism involved in spontaneous convulsions in persons. Nevertheless, it seems worth while to inquire to what extent factors which are known to modify convulsions in patients have a similar effect on convulsions experimentally induced in animals.

For these experiments, eighty-seven rabbits were used. Two convulsants were employed, thujone, made from oil of wormwood, and homocamfin, a preparation of camphor suitable for intramuscular injection in man. Thujone has been used recently by Uyematsu and Cobb,[1] Elsberg, Stookey and Pike,[2] Dandy,[3] Florey,[4] Sparks,[5] Muncie and Schneider [6] and by others. The method of judging results is important. Most of the authors named found for each animal the minimum amount of the convulsant which would induce a convulsion under normal and experimental conditions. In such a method it is assumed that the reaction of a given animal to a given dose is fairly constant from time to

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* From the Department of Neuropathology of Harvard Medical School, and the Thorndike Memorial Laboratory of Boston City Hospital.

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3. Dandy, W. E., and Elman, R.: Studies in Experimental Epilepsy, Bull. Johns Hopkins Hosp. **36**:40 (Jan.) 1925.

4. Florey, A.: Observations on the Action of Convulsant Thujone, J. Path. & Bact. **28**:645 (Oct.) 1925.

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6. Muncie, W. S., and Schneider, A. J.: A Study of the Convulsions Produced by Wormwood, Bull. Johns Hopkins Hosp. **42**:77 (Feb.) 1928.

time, and that the use of a larger dose of the drug will be followed by a reaction which is proportionately more severe.

We endeavored to follow this method, but obtained inconsistent results. On one occasion a rabbit might have no reaction from an amount of thujone which, on another occasion, would produce a fatal convulsion. We made a number of observations concerning the effect on convulsions of such procedures as blocking of the rectum, and the preliminary injection of insulin, dextrose, epinephrine or histamine, but because of the lack of uniformity in the control injections the results did not justify the drawing of conclusions. Because of this difficulty in judging the reaction of an individual rabbit, we adopted the method of injecting groups of animals with a constant dose of the drug and observing the proportion of reactions which resulted. This statistical method requires many more observations than the other, but is more reliable.

TABLE 1.—*Percentage of Convulsions Following Injection of Various Doses of Thujone*

	Mg. Thujone per Kilogram Injected in a Vein of the Ear				
	4-5	6	7-8	9-12	Total
Total experiments	52	50	64	25	191
Number reacting	35	39	55	23	152
Percentage reacting	68	78	86	92	80

The frequency of reactions with reference to the amount of thujone injected is shown in table 1. In all, 191 control injections with thujone were made, of which 80 per cent resulted in a convulsive manifestation. As one might expect, the proportion of animals reacting increased progressively with the amount of drug injected. Such increase, however, was not proportional to the amount injected. Following an injection of from 9 to 12 mg. of thujone per kilogram of body weight, 92 per cent of the rabbits reacted, whereas when half this amount was injected, the proportion reacting was only 26 per cent less.

In these preliminary observations, in order to insure accuracy of measurements, the thujone, which is an oil, was used in a 5 or 10 per cent mixture with Norwegian cod liver oil. Thinking that the lack of constancy in the occurrence of convulsions might be due to incomplete mixing of the two oils, we added thujone to blood serum and made an emulsion by agitating the mixture in a shaking machine. The injection of this emulsion resulted in more severe convulsions than the injection of the unemulsified mixture. Because the severity of the reactions seemed to vary somewhat with the fineness of the emulsion, and this did not remain constant on standing, we discontinued its use. Dissolving the thujone in alcohol produced reactions which were more severe and uniform than those following the injection of a mixture. The intra-

venous injection of the alcoholic solution, however, produced necrosis of the animals' ears, so that continued use of this method was not feasible.

On the advice of Dr. Soma Weiss, we also used a preparation of camphor, made soluble by means of salicylic acid. This preparation, called homocamfin, is designated for intramuscular injections in man. Austregesilo [7] found that convulsions followed the use of a camphor-bromide preparation in five patients being treated for gonorrhea. Apparently, homocamfin in the doses prescribed has no convulsant action in man.

The dosage of homocamfin which we used, 6 mg. per kilogram of body weight, produced the same proportion of reactions as was obtained

TABLE 2.—*Effect of Fasting and Fat Feeding on Convulsions Induced by Intravenous Infection of Homocamfin*

Period	Number of Experiments	Resulting Convulsions			Bicarbonate of the Blood			
		Number	Percentage	Severity	Number	High	Low	Average
Control.....	75	59	78.6	1.61	4	33.0	45.1	39.1
Fasting.....	37	14	37.9	0.56	26	25.6	50.5	40.3
Postfasting....	5	3	60.0	1.20	7	40.1	62.5	51.3
Fat feeding....	23	13	56.5	0.87	15	16.6	45.3	29.7

TABLE 3.—*Effect of Fasting and Fat Feeding on Convulsions Induced by Intracardiac Infection of Homocamfin*

Period	Number of Experiments	Resulting Convulsions			Bicarbonate of the Blood			
		Number	Percentage	Severity	Number	High	Low	Average
Control.....	29	26	89.6	2.29	19	54.4	31.6	46.6
Fasting.....	25	24	96.0	2.08	21	33.0	59.8	43.7
Postfasting....	18	15	83.6	2.17	14	33.4	60.1	45.8
Fat feeding....	16	15	93.7	2.18	14	15.4	46.2	30.2

with injections of thujone. The objection to homocamfin is that it is irritating and causes thrombosis of the veins of the ears. For this reason the intravenous injection in an individual animal could be made a limited number of times only. In many animals, therefore, we injected the drug directly into the heart. Effort was made to insert the needle into the left ventricle. An autopsy on the animals which died showed that ordinarily this effort was successful. We found that the injection of the homocamfin into the heart was a somewhat more certain method of inducing convulsions than when the injection was intravenous. Seventy-eight per cent of the seventy-five rabbits given injections into the vein of an ear (table 2), reacted; convulsions resulted in 90 per cent of the twenty-nine rabbits given injections of the same amount into the heart (table 3). The average severity of the convulsion was

7. Austregesilo, A.: Ataques epileptoides produzidos pilo uso do brometo de camfora, Clinica neurol., Rio de Janeiro, Francisco Alves & Co., 1927, p. 252.

greater following an intracardiac injection. These observations are contradictory to those of Florey,[4] who stated that convulsions did not occur when thujone was injected into the carotid artery.

REPEATED INJECTIONS

In using the same animal for repeated injections, it is important to know whether such injections make the animal more or less susceptible to convulsions. Elsberg [2] and Sparks [5] observed that convulsions induced daily seemed to make the animal relatively resistant to the drug. We did not observe that animals given injections daily for several days, or several times a week for long periods, thereby became any more or less liable to convulsions. Concerning injections repeated after an interval of minutes, Florey [4] stated that in no case did a second

TABLE 4.—*Effect of Repeated Injections of Convulsant Drugs on Occurrence and Severity of Convulsions*

Amount Injected per Kilogram	Number of Experiments	Percentage Having Convulsions: First Injection, per Cent	Second Injection, per Cent	Third† Injection, per Cent	Severity of Convulsions*: First Injection	Second Injection	Second Percentage of First
4-5 or 6 mg. thujone	29	62	44	63	0.90	0.65	72
7-8 or 9 mg. thujone	18	89	25	63	1.44	0.28	20
Total	47	72	38	64	1.10	0.51	46
6 mg. homocamfin	12	100	50	45‡	2.16	1.08	50

* In this calculation the following values are assigned to the severity of the convulsion: slight, 1; moderate, 2 and severe, 3. These values are added and the sum divided by the number of experiments.

† Based on seventeen experiments only.

‡ Based on seven experiments only.

convulsion arise, but that such an increased amount produced death rather than a fit. In our experience, however, a previous injection with resulting convulsion by no means protected an animal from having a convulsion. Here again individual results were not consistent. On one occasion a rabbit might not have a convulsion after the first injection and yet have a severe one after the second, whereas on another day the results might be reversed.

Our statistical data on this point are presented in table 4. In these experiments, subsequent injections were given from thirty minutes to one hour after the previous injection. In this table the experiments with thujone are divided into two groups with relation to the amount injected. Of twenty-nine experiments, in which 0.06 cc. or less of thujone was injected intravenously, 62 per cent of the animals had a convulsion. On the second injection of a similar amount, 44 per cent reacted. When larger amounts of thujone were given, a smaller proportion of animals responded to the second injection. In the experi-

ments with a larger dose, 89 per cent had a reaction with the first injection, and only 25 per cent with the second. In the last three columns of table 4, comparison is made with reference to the severity of the convulsions rather than their incidence. For this purpose a slight reaction, in which there was merely twitching of ears and head, was given a value of one; a moderate reaction, in which the generalized convulsive movements were not strong enough to throw the animal to the floor as two, and a severe convulsion as three. Using these values, we find that the average reaction following the first injection was 0.9, and following the second injection 0.65. Following an injection of 0.07 cc. or more per kilogram of body weight, the value for the first was 1.44 and for the second, 0.28. In the experiments in which the smaller amount was injected, the second injection was 72 per cent as severe as the first, whereas when a larger amount was used the second convulsion was only 20 per cent as severe as the first. These results are of interest because of the clinical observation that if patients who are subject to frequent small seizures have a generalized convulsion a period of comparative freedom from seizures often follows. In the experiments with thujone, 64 per cent of the rabbits receiving a third injection reacted. This figure, however, is based on experiments with only seventeen animals. In the case of repeated injections of homocamfin, much the same thing occurred as with thujone. The second injection resulted in one-half as many convulsions as the first. The number of experiments with homocamfin was small.

EFFECT OF PHENOBARBITAL SODIUM

In order to have a therapeutic standard for comparison, we determined the effect on convulsions of various amounts of phenobarbital. For this purpose a 1 per cent solution of phenobarbital sodium was used, and various amounts based on body weight were given. Results of these experiments are shown in table 5 and chart 1. The first effort was to give a dose of phenobarbital which might be comparable to that used in persons. Six milligrams per kilogram of body weight was given intraperitoneally daily for several days. This dosage of phenobarbital is the equivalent of approximately 6.5 grains (0.43 Gm.) daily to a person weighing 70 Kg. The injection of homocamfin was made twenty-four hours following the previous injection of phenobarbital. As will be seen from chart 1, this amount of phenobarbital did not cause a reduction in the frequency or severity of seizures.

In another experimental period, three and one-half times this dose was used and homocamfin was injected approximately fifty minutes after the administration of phenobarbital. In this series there was slight though definite decrease in both the number and the severity of seizures.

In still another series an amount of phenobarbital double this dose, 0.04 Gm. per kilogram of body weight, was given approximately thirty minutes before the injection of homocamfin. In these animals there was a definite effect on convulsions, the proportion responding being

TABLE 5.—*Effect of the Administration of Phenobarbital Sodium on Convulsions Induced by Intracardiac Injection of Homocamfin*

Number of Experiments	Grams of Drug per Kilogram	Average Time Before Injection	Resulting Convulsions			Bicarbonate of Blood	
			Number	Percentage	Severity	Number	Average per Cent by Volume of Carbon Dioxide
16	0.006	24 hours	16	100	2.44	7	52.3
19	0.02	50 minutes	16	84.2	1.63	6	42.9
12	0.04	30 minutes	7	58.0	0.91	5	45.4

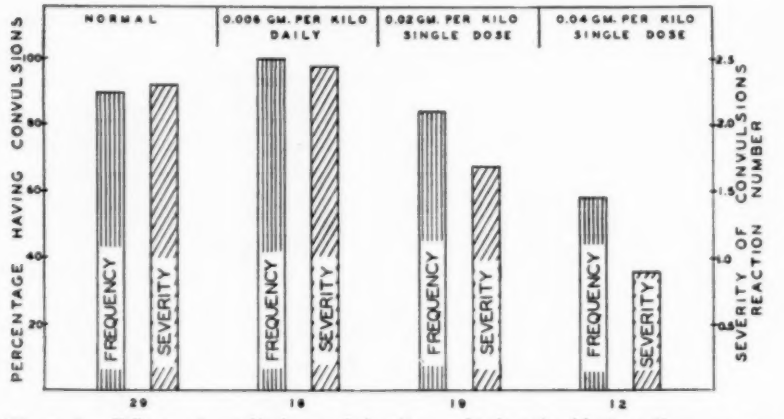

Chart 1.—Effect of preliminary injections of phenobarbital sodium on convulsions induced by drugs. The right hand ordinate indicates the degree of severity of the convulsions as explained in the text; the left hand ordinate indicates the proportion of injections which resulted in a reaction. The figures at the bottom indicate the number of experiments. The second pair of columns show the reaction when the drug was given twenty-four hours after an injection of 0.006 Gm. of phenobarbital per kilogram of body weight. The third pair indicate the reaction obtained fifty minutes after the injection of 0.02 Gm. per kilogram of body weight. The last pair shows the reaction following an injection of 0.04 Gm. per kilogram. Only with the larger amounts was there a definite reduction in convulsions.

60 per cent in place of 90 per cent as in the control series. The severity of convulsions was somewhat disproportionately reduced. The amount of phenobarbital given, corresponding to approximately 42 grains (2.73 Gm.) for a person weighing 70 Kg., far exceeded the amount used clinically. The animals were in a state of partial anesthesia. The

results are much the same as those obtained by Sparks [5] in several dogs similarly tested. In view of these results we would expect that only measures which would profoundly affect the animal would give noticeable effect on convulsions induced by means of a convulsant drug.

FASTING AND FAT FEEDING

Recent clinical reports have demonstrated that in many persons epileptic convulsions can be greatly reduced by means of fasting or a fat diet. This evidence has been reviewed recently by Lennox and Cobb.[8] A group of rabbits were made to fast for a period of from five to eight days. As seen in table 2, and the right hand side of chart 2, when homocamfin was injected intravenously during the course of the fast, the proportion of convulsions resulting was considerably reduced. A group of animals were starved but during the fasting period were given feedings by tube, consisting of melted butter and oil. From 25 to 50 cc. of this mixture was given by stomach tube daily. The animals which received this fat feeding showed some reduction in the proportion of seizures following the intravenous injection of homocamfin.

In the same group of animals, fifty-nine injections were made into the heart. The resulting reactions, as shown in table 3 and in the left hand portion of chart 2, were more frequent and severe than when the drug was injected intravenously. The explanation for this discrepancy is presumably the fact that when introduced directly into the heart, the drug reaches the brain in an overwhelming amount and concentration. Any alteration in circulation or in irritability of nerves which resulted from fasting and which tended to cause a decrease in convulsions would be manifest only when the drug was introduced intravenously and reached the brain in a more dilute form.

RELATION TO BICARBONATE OF THE BLOOD

We have found that the decrease in seizures which occurs when patients are fasting or on a fat diet parallels the reduction in the bicarbonate of the plasma. We measured the bicarbonate of the blood in many of these animals. Blood, in most instances, was drawn from the left side of the heart, and the carbon dioxide combining power was measured in the van Slyke apparatus. Individual measurements showed considerable variation. This may have been due in part to the fact that some of the animals struggled when being placed on the animal board. The average results of the measurements made are shown in tables 2 and 3. Individual measurements are shown in chart 3. In twenty-three measurements made on control animals, the average

8. Lennox, W. G., and Cobb, S.: Epilepsy, from the Standpoint of Physiology and Treatment, Baltimore, The Waverly Press, 1928.

bicarbonate per cubic centimeter of whole blood was 45 per cent by volume. Asada [9] reported a reduction in the alkali reserve of fasting rabbits. In our animals there was no reduction, the average of forty-seven measurements being 42 per cent by volume. The absence of reduction of bicarbonate in these fasting animals is presumably due to the large supply of glycogen which their bodies contain. Acetone was absent from the urine and blood plasma. In the animals which were fed a fat mixture, there was a distinct decrease in the average concentration of the bicarbonate of the blood to 30 per cent by volume. As these animals did not show the presence of acetone bodies in the urine, and as they did not maintain weight any better than their fasting comrades, it is doubtful whether this fat was absorbed and utilized.

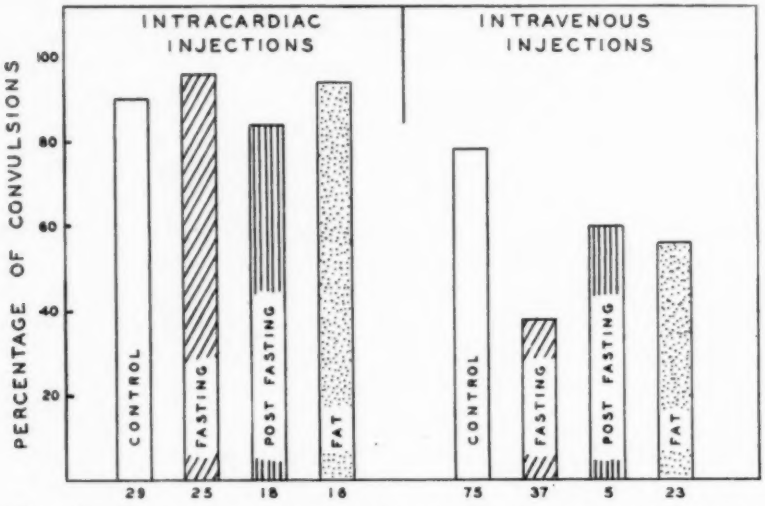

Chart 2.—Results of the injection of homocamfin into animals being made to fast or being fed only fat. The ordinate represents the percentage of animals reacting with a convulsion. The figures below the column indicate the number of the experiments. The unmarked column indicates the control series, the cross hatched column the fasting animals, the perpendicularly hatched the same animals in the period following fast and the dotted column the fasting animals which were given daily feedings of butter and oil by stomach tube. Only in rabbits into which intravenous injections of the convulsive drug had been made was there a reduction in the incidence of convulsions during the experimental periods.

The fact that they invariably developed a severe diarrhea is against this and also probably accounts for the acidosis which they showed.

The decrease in the number and severity of convulsions following the intravenous injection of homocamfin into fasting animals being given

9. Asada, H.: Acidosis During Starvation, Am. J. Physiol. **50**:1 (Oct.) 1919.

fat might be explained by the attendant acidosis. The same explanation could not account for the reduction in convulsions in the fasting group, for they did not show any acidosis. Neither could the severity of seizures be related to the concentration of bicarbonate in the blood drawn before the convulsant drug was injected. Inspection of chart 3 demonstrates this. Blood taken after a convulsion showed a marked decrease in the bicarbonate of the blood, the result of the muscular exertion.

INJECTIONS OF ACIDS AND ALKALI

Lennox and Cobb [8] showed that acidosis induced by means of the ingestion of acids or of acid-forming salts in certain epileptic patients

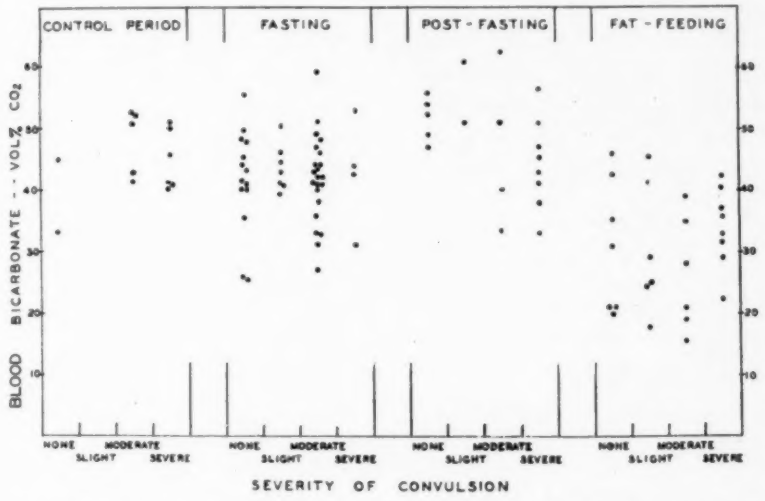

Chart 3.—Individual measurements of the bicarbonate in the blood during experimental periods and with respect to the severity of the convulsion which follow the injection of homocamfin. The lettering at the bottom indicates the degree of severity of convulsions. The ordinate indicates the carbon dioxide combining power of the whole blood. Blood was drawn from the heart immediately before the injection, which in some instances was into the heart, in others into a vein of the ear. The level of blood alkali did not bear relation to the severity of the convulsion. Only in animals being fed fat was there distinct evidence of a lowered alkali reserve.

tends to decrease the frequency of seizures, whereas the induction of alkalosis tends to increase them. The evidence concerning the effect in animals is contradictory. Thus, Elias [10] found that the previous ingestion of acids increased the susceptibility of the animal to seizures

10. Elias, H.: Säure als Ursache für Nervenübererregbarkeit, ein Beitrag zur Lehre von der Acidose, Ztschr. f. Immunitätsforsch. u. exper. Therap. **27**:1, 1918.

from electric stimulation. Fröhlich and Solé [11] observed the opposite condition. Wenner and Blanchard [12] found that induction of acidosis in dogs protected them from an otherwise fatal dose of strychnine.

We performed fourteen experiments on rabbits (table 6). These observations were too few to be treated on a statistical basis, so that the results are suggestive only. In four experiments, lactic acid was injected into the heart. In the first experiment, in which a 2.5 per cent solution was used, there was little reduction in the bicarbonate of the blood,

TABLE 6.—*Effect of Injections of Acid and Alkali on Convulsions*

Substance	Amount Injected	Bicarbonate of Blood: Before Injection, per Cent by Volume	Bicarbonate of Blood: Before Homocamfin, per Cent by Volume	Interval, Minutes	Result of Injection of Homocamfin into Heart
Lactic acid injected into heart	6.5 cc. 2.5% (2.9 cc. per Kg.)	55.1	48.3	10	Severe convulsion; died; carbon dioxide after death, 34.1 per cent by volume
	6.2 cc. 5% (1.5 cc. per Kg.)	36.7	2.2	17	None; died eight minutes after injection of camphor
	7 cc. 5% (1.5 cc. per Kg.)	25.4	2.7	10	None; found dead next day
	4 cc. 10% (1.5 cc. per Kg.)	46.3	2.6	8	None; found dead next day
Acetone injected into a vein of the ear (1.5 cc. per kilogram)	3.4 cc.	50.3	43.5	5	Running movements of hind legs, rolled over and over; died; carbon dioxide after death, 33.2 per cent by volume
	3 cc.	45.4	35.6	14	A few jerks of limbs; became rigid; died
	3 cc.	39.1	44.1	..	Died before injection of homocamfin; urine had a marked sodium nitroprusside reaction
Acetone in heart (1.5 cc. per kilogram)	2.8.	51.5	44.2	11	Jerking of hind legs; rolling
	3.1.	50.7	52.2	10	Slight convulsion; rolling movements
	3.4.	30.4	33.6	8	Twitching of ears only; extension of legs if touched
	3.1.	39.8	29.6	5	A little jerking of head
Sodium bicarbonate, 10% (5 cc. per kilogram)	10.5 cc.	36.4	61.9	5	Moderate convulsion
	11.5 cc.	41.8	50.1	5	Moderate convulsion
	9 cc.	48.4	69.6	5	Severe convulsion

and the animal had a severe convulsion when an injection of homocamfin was made ten minutes later. In the three other experiments, in which a 5 per cent solution was used, no convulsion resulted from the subsequent injection of homocamfin. The carbon dioxide combining power of the blood in these three animals was almost nothing. The blood

11. Fröhlich and Solé: Der Einfluss von Säuren und Alkalien auf die Wirkung einiger Krampfgifte, Arch. f. exper. Path. u. Pharmakol. **104**:32, 1924.

12. Wenner, W. F., and Blanchard, E. W.: Effect of Acidosis on Strychnine Poisoning, Proc. Soc. Exper. Biol. & Med. **25**:726 (June) 1928.

itself was extremely dark and apparently hemolyzed. Yet, except for dyspnea and unwillingness to move about, the rabbits appeared fairly normal after the injection. They were all found dead the next day. The evidence with these rabbits favors the sedative effect of acidosis. The amount of lactic acid injected, however, produced a condition far beyond that which could be produced clinically.

Acetone was injected into the hearts of four animals. This chemical, unlike diacetic acid, has little effect on acid-base relationships. Its injection did not make a consistent change in the bicarbonate content of the blood. Each of the four animals receiving injections had a convulsive reaction, though somewhat less severe than the usual convulsion.

In three instances, injections of sodium bicarbonate in 10 per cent solution were made into the heart. The amount used was sufficient to cause marked increase in the bicarbonate of the blood. In each instance a convulsion resulted, two being moderate, and one severe. These results are inconclusive. They suggest that in the presence of severe acidosis the reactability of the rabbits to a convulsive drug is reduced.

CONCLUSIONS

Eighty-seven rabbits were used for experiments in which injections of thujone or homocamfin were made into the blood stream. Because of the variability in reactions obtained from time to time it was found necessary to treat observations on a statistical basis. The incidence and severity of the reactions did not increase in proportion to the increase in the amounts injected. Reactions were more frequent and severe after intracardiac than after intravenous injection.

When the convulsant dose was repeated within an hour, the resulting convulsion was less frequent and severe than the first; the larger the dose used, the greater was the difference between the first and second reactions.

Preliminary medication with phenobarbital sodium caused reduction in convulsions only when the dose, based on weight, far exceeded that used clinically. Reduction in severity exceeded reduction in incidence.

Rabbits which were made to fast did not show a reduction in the carbon dioxide combining power of the blood. Those which were fed butter and olive oil showed reduction, presumably because of the diarrhea induced. In both groups of animals there was some reduction in the frequency and severity if the convulsant drug was injected intravenously, but not if it was injected into the heart.

Of the rabbits' reactions, the severity was not related to the concentration of bicarbonate in the blood.

Following the injection of amounts of lactic acid sufficient to reduce the bicarbonate greatly, the animals did not have convulsions. Injections of acetone into the heart did not consistently reduce the bicarbonate in the blood or the severity of the attacks. The injection of sodium bicarbonate did not have a definite effect on the induced convulsion. Each of the experiments cited was performed on only three animals.

The use of a convulsant drug is such a powerful agency that only profound changes in body metabolism will modify the resulting convulsions. Therefore, it is hardly a suitable means for studying factors which might affect the occurrence of seizures in patients.

CRANIAL HYPEROSTOSIS ASSOCIATED WITH UNDERLYING MENINGEAL FIBROBLASTOMA *

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At the April, 1899, meeting of the Section on General Medicine of the College of Physicians of Philadelphia, I presented a man who had partial paralysis of the right side of the body, with other symptoms, and hyperostosis of the left side of the cranium. The association of these conditions made the case important, and I was unable to find a report of a similar case in the literature. At my request an operation was performed in the region of the hyperostosis, and this resulted fatally. At the May, 1899, meeting of this section I reported, with Dr. T. S. Kirkbride, Jr., a review of the case; Dr. Kirkbride, as pathologist to the hospital, reported his pathologic examination. The title of the paper appears in the Transactions of the College for the year 1899.

Brissaud and Lereboullet [1] described this condition in 1903, under the name of hemicraniosis; they reported two cases, one of them with necropsy. By its outer surface the dura was supposed to cause proliferation of bone and by its inner surface, the formation of tumors.

Parhon and Goldstein [2] reported a similar case with operation. Parhon believed that a relation of cause and effect existed between the tumor of the bone and that of the brain; Babès believed that there was no doubt of this, as the consistency showed that the bony tumor must be very old, and he believed that it probably caused the psammoma by the irritation of the meninges.

Parhon and Nadjede [3] reported a case with necropsy which belonged in this group. A case was also reported by Barling and Leith.[4] These were the only case reports I could find in the literature when I published the notes of two cases with operation, one of which was the case previously mentioned. In my paper,[5] published in 1907, I expressed my belief that any pronounced local thickening of the cranium is likely to be associated with a tumor growing from the dura, and that operation

* Submitted for publication, Nov. 5, 1928.
* Read at a meeting of the Society of Neurological Surgeons, Oct. 26, 1928.

1. Brissaud and Lereboullet: Rev. neurol. **11**:537, 1903.
2. Parhon and Goldstein, cited by Parhon and Nadjede: Rev. neurol. **13**:1017, 1905.
3. Parhon and Nadjede: Rev. neurol. **13**:1017, 1905.
4. Barling and Leith: Lancet **84**:282, 1906.
5. Spiller, W. G.: Hemicraniosis and Cure of Brain Tumor by Operation, J. A. M. A. **49**:2059 (Dec. 21) 1907.

should be attempted as soon as cerebral symptoms become manifest. It might in this way be possible to remove the tumor while it is still small.

At a meeting of the Society of Neurological Surgeons in Philadelphia, in 1921, I exhibited a collection of tumors, among them specimens illustrating the condition now under consideration. I expressed my belief that hyperostosis of the cranium produced by trauma, syphilis or other cause might by irritation lead to the formation of an underlying fibroblastoma. The work of Cushing,[6] Penfield [7] and Phemister [8] has shown in many cases that tumor cells are present in the hyperostosis. In my first case, tumor cells probably were present in the thickened bone. The removal of a part of this bone caused profuse hemorrhage.

There seems to be no doubt that tumor cells of the same character as those of the fibroblastoma usually may be found in the hyperostosis, but I have not believed that it has been fully established that the enlargement of bone is invariably secondary to the formation of tumor of the dura. I do not know that anyone has reported infiltration of the bone by tumor cells of moderate degree without any enlargement of bone, suggesting an early stage of the process. In the case of Barling and Leith, the bone over the center of the tumor for an area of about three fourths of an inch was slightly thickened, more spongy and more vascular than normal. The inner table was rather extensively destroyed by tumor growth which penetrated in masses into some of the inner spaces of the diploe. This can hardly be called an early form of the lesion.

If a single case can be found in which there is hyperostosis of the cranium without infiltration of the bone by the tumor immediately above a fibroblastoma of the dura, it establishes the fact that the two conditions may be associated and that the enlargement of bone is not invariably produced by the infiltration of tumor cells. This is the position I have held.

I have in fact the specimen from such a patient who was under the care of Dr. A. P. C. Ashhurst.[9] He removed a pronounced enlargement of bone immediately above a fibroblastoma of the dura with the tumor, and careful microscopic study of this bone by the late Dr. A. J. Smith, professor of pathology in the University of Pennsylvania, by Dr. Lucké, Dr. Winkelman and myself has failed to reveal any infiltration of this bone by tumor cells. The specimen is beautifully stained, and it is not

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6. Cushing, H.: Cranial Hyperostosis Produced by Meningeal Endotheliomas, Arch. Neurol. & Psychiat. **8**:139 (Aug.) 1922; Brain **45**:282, 1922.

7. Penfield: J. Neurol. & Psychopath. **4**:27, 1923; Surg. Gynec. Obstet. **36**: 657, 1923.

8. Phemister, D. B.: The Nature of Cranial Hyperostosis Overlying Endothelioma of the Meninges, Arch. Surg. **6**:554 (March) 1923.

9. Ashhurst: Ann. Surg. **72**:402, 1920.

reasonable to suppose that tumor cells were removed by the technic, as the tissue is shown most satisfactorily. If normal bone may be infiltrated by tumor cells in such a way as to produce an enlargement, it is certainly reasonable to suppose that diseased bone with lessened vitality may also be invaded by tumor cells. I am not at all sure that in the reported cases in which the bone has been found to contain tumor cells the proof has been offered that the tumor formed first and the enlargement of the bone was secondary. This may be possible in many cases, but it seems to me also possible that the enlargement of the bone may come first.

This may be a fact of considerable medicolegal importance. In a letter to me, Dr. Penfield has made the following statement:

> It is perfectly possible to have a lump on the head which is due to bony thickening as the direct result of trauma without the development of any endothelioma. It has always seemed that your suggestion that trauma may very likely be a causative agent in these osteogenetic tumors is a very good one and it is possible that there might well be thickening in the bone due to a blow and then there might have developed beneath the site of the blow, an endothelioma which did not invade the bone. This is a rather different process from the bony enlargements which are infiltrated with neoplasm.
>
> I am sending you two sections of a recent case of mine, of a man who was a miner and was struck by a slide of coal in the mine. I found coal pigment in the scalp at the site of the blow. Beneath this was found the bone which is seen in the section I am sending you and beneath that and the dura was a large meningeal fibroblastoma which is a name we are using for dural endothelioma. In this case the signs of intracranial tumor appeared about a year after the accident and in this case the history of trauma and its relation to the case is very clear.

In Dr. Penfield's case, the bone was infiltrated by tumor cells, but this does not affect the relation of trauma to the development of the fibroblastoma.

In the discussion of a paper by Holmes and Sargent on endothelioma at the base of the brain, held before the Section of Neurology of the Royal Society of Medicine of London, at a meeting with members of the American Neurological Association, Penfield [10] made an important statement which was published in a recent number of *Brain*. He asserted that enlargement of bone at the base of the skull from tumor infiltration, in association wtih an adjacent endothelioma, would be of diagnostic importance in regard to the question at issue. In none of his cases did he find invasion of the bone at the base. The point is well taken. Trauma is much less likely to cause bony enlargement at this part of the skull, and in the cases reported at this meeting, such enlargement or invasion was not found. As far as I know, in no case of fibroblastoma at the base of the skull has infiltration of bone by the tumor been described.

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10. Penfield: Brain **50**:536, 1927.

Pancoast [11] has observed that the fibroblastomas arising in the sagittal portion of the vault and the base adjacent to the sylvian fissure are the ones more likely to have associated bony outgrowths. In the basal location, the x-ray appearance is that of a diffuse bony thickening involving the squamous portion of the temporal bone, the greater or lesser wings of the sphenoid, or the orbital plate of the frontal bone, or all of these. He has found by x-ray examination that extensive hyperostoses involving the vault and base change in character from the radiating spicule type to the dense thickening as the base is approached.

NOTE.—I have examined a meningeal fibroblastoma at the base with thickening of the underlying orbital plate, studied by Dr. N. W. Winkelman. He found on gross examination that the orbital plate under the tumor was four or five times the thickness of the opposite orbital plate. Microscopic examination of the bone showed the thickening with increase in size of the bony spaces, most of which were filled with normal marrow. In only one place was there tumor tissue which to the naked eye appeared no larger than the head of a pin; this tissue was made up of several microscopic clumps of fibroblastomatous material, very similar to the overlying tumor. Dr. Winkelman thinks it is probable that in some of the reported cases the normal marrow has been mistaken for neoplastic tissue.

It seems to me that this observation by Dr. Winkelman is evidence that in his case the thickening of bone was in no way the result of infiltration by tumor cells.

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11. Pancoast: Personal communication to the author.

THE NEUROLOGIC BASIS OF ELEMENTARY EDUCATION *

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Education in the broader sense is to be looked on as the whole of the process of training a child, beginning with earliest infancy, and thus including the extremely important period of pre-school training as well as academic education in its ordinary usage. Before a child enters school he has acquired a large storage of word meanings which have been implanted by way of the auditory path and which serve him as models for speech. He has thus already learned to use the third cerebral level of elaboration by way of the auditory mechanisms, but in the visual field he has not progressed beyond a use of the second elaborative level. He does make use of visual material controlling movement, and use of visually acquired objective data and associations have been formed between objects which he has seen and their names, thus linking the second visual level with the third auditory, but there has not as yet been any training for association of a symbol with its corresponding sound (letter) or of the association of a series of such symbols with the series of sounds forming a word which constitutes reading. One may thus look on the task of early academic education as chiefly the addition of the visual element to the auditory training which has already been begun at the third level.

The evidence of the existence of three progressive steps in cerebral elaboration of sensory material is to be derived from the study of acquired neurologic disturbances resultant on brain damage, such as cortical blindness, mind blindness and word blindness, and is also reinforced by studies of failure of acquisition of the third level function. This source of illuminative material stands out clearly in cases of strephosymbolia. These children have a good visuomanual association and are hence often dextrous in the use of their hands; they may also make good use of pictorial material, but fail entirely in ability to understand the meaning of words from printed symbols. In one case which I have already reported,[1] a boy, aged 17, with good manual control, showed unusually good use of pictorial data. He gave a rating by the Healy pictorial completion test that ranked him with the highest 10 per cent of normal persons;

* Submitted for publication, June 29, 1928.

* Read before the Fifty-Fourth Annual Meeting of the American Neurological Association, Washington, D. C., May, 1928.

1. Orton, S. T.: Wordblindness in School Children, Arch. Neurol. & Psychiat. **14**:581 (Nov.) 1925.

in spite of this evidence of good vision at the lower levels of elaboration he could read only with the ability of a child in the first grade. A similar difference between the availability of visual and auditory material at the third level shows strikingly in many cases of special spelling disability, certain writing defects and in certain stutterers whose handicap is more strikingly apparent in attempting to read aloud than when attempting propositional speech.

The neurologic background of elementary education seems to have been almost entirely overlooked in current educational circles. The methods employed in teaching today are apparently largely determined by the results of average accomplishment in large groups of children and do not seem to have taken cognizance of the fact that certain children with good intelligence may deviate from the average in their ways of learning, so that pedagogic methods which may advance the class as a whole much more rapidly may yet serve as an almost insuperable obstacle to children within that class. Since elementary education consists of the establishment of association (or, if one wishes, the conditioning of reflexes) at the third level of visual elaboration and aims at the free interplay of visual and auditory implantations in control of both speech and writing, it would seem that the neurologic background may offer invaluable aid for the selection of those children who differ from the average in learning requirements and may also suggest special methods for their education.

INTERACTION BETWEEN THE AUDITORY AND VISUAL SPHERES

A facile interaction between the auditory and visual spheres is obviously necessary for reading. The visually acquired material must form a quick and secure association with the word meaning which has previously been implanted by the auditory path in order that the meaning of the printed word may be understood. A failure of this prompt linking results in strephosymbolia. That the visual factor is also operative in spelling is obvious when one recalls that it is only by visual implantation that one is able to remember the silent letters in words. Again, as the child progresses in school, reading forms one of the main pathways by which new words are implanted. That such words are useful in speech will, I think, be immediately apparent to any one who can recall his own hesitant attempts at the pronunciation of the word which is simple to him in reading, but which he has never heard pronounced by another. Neither the visual nor the auditory path will suffice alone for the cultivation of a vocabulary as higher levels of the educational plane are reached, and I believe that both operate together in the control of both speech and writing, although the importance of either is apt to be dependent on the quality of the speech and on the type of implantation

which has preceded it. Thus Lincoln's vocabulary has been held as a striking example of the influence of early reading on later speech habits.

My studies to date of special difficulties in the field of arithmetic are by no means sufficient to form an opinion concerning the interplay between the visual and the auditory here, but the spatial element of the decimal system and the progressional element in addition, subtraction, multiplication and division would all seem to indicate the need of cooperation between the visual and the auditory in the acquisition of even the fundamentals of this subject.

There is one fundamental necessity for the easy establishment of an association or for an easy conditioning of reflexes. This is constancy of presentation of the stimuli to be so linked. When there is much variation either in form or in time of presentation the linking is loose or is not established. The effect of this, I think, is to be seen in normal children who have much more difficulty with those letters which have a varying sound value, such as the *s* and *k* sound of *c*, the hard and soft sounds of *g* and the various sounds of the vowels. In normal children one observes that errors in vowels are much more frequent than those of the consonant sounds which are associated with a single symbol, such as *t*, *f*, *l*, *n* and *b*. Children who are later to become secure readers, however, overcome this difficulty relatively quickly, but it remains to a noticeable degree in those children who later show specific elements of reading disability. Children suffering from strephosymbolia show a weak and insecure association between the symbol *a* and the sounds *ā*, *ă*, *ä*, and often confuse the short sounds of *ă*, *ĕ* and *ĭ*. Another factor which stands out with prominence in these children is the striking tendency to confuse *b* and *d* and *p* and *q*. Sometimes these pairs of letters are consistently interchanged so that *b* is always read as *d*, but much more often the *b* and *d* have an equivalent value. In one of my recent cases, *b* and *d* were so completely interchangeable that baby, bady, daby and dady all meant baby to the subject. There is here apparently a complete equivalence of either letter and its mirror counterpart. Sometimes, however, the children do not show this facility for substituting one letter for another, but when either letter is encountered they show bepuzzlement, and the same indecision as to what a letter means is found in connection with other letter symbols which cannot be confused by reversal. I think, therefore, that while the confusion between the symbol and its mirrored counterpart is easily demonstrable with *b*, *d*, *p* and *q*, it probably also operates with other letters, resulting not in an interchange, but in a puzzling indecision.

Another interference with the normal processes of reading is seen in a striking tendency toward sinistrad progress within the word, which is one of the characteristic earmarks of strephosymbolia. Such

sinistrad reversals in direction are to be seen fairly frequently in practically all young children who are just starting to read, but those who acquire reading readily soon correct this tendency, while in those with a reading disability this continues to show itself in a variety of ways. Sometimes the whole word is read in reverse direction and *was* becomes *saw*, *on* becomes *no*, *not* becomes *ton*, etc. Again most of the word may be read correctly but a pair of letters is reversed as when gray is read gary, and target is read as targret, etc. Such words as calm and clam form almost insoluble puzzles for these children. Occasionally, children who have learned to read with considerable facility exhibit this reversing tendency strikingly in their attempts at oral or written spelling. No matter how one may look on the problem of cerebral localization, the major fact of antitropism of the two hemispheres remains, and the sinistrad progress is the natural expression of right hemispheric activity as dextrad progress is that of the left.

I think that one may now postulate from a study of the product of a large number of cases of reading disability and a somewhat smaller number of spelling defects that there are in all probability two factors operative here: (1) a tendency toward confusion in mnemonic recall between the original symbol and its antitrope, and (2) a tendency toward sinistrad progress within a word. The first of these, which is a static or orientation factor, I relate to an uncertainty of constant selection of the engram of one hemisphere. The second, which is a kinetic or progressional factor, is more closely related to the normal direction of progress for the left handed. I cannot as yet speak concerning the relative frequencies or the relative severity of these two factors, but apparently the children who suffer from the most severe handicap in reading exhibit both factors to a considerable degree, and it is possible that either of these alone may form a minor obstacle to reading progress but that a severe reading disability rests on their coexistence. There is also some suggestive evidence that these two factors may be separately inherited.

Many other types of errors in the reading attempts of these children are to be observed. They may make many errors in pronunciation of vowels. They often omit or add letters, words or parts of words. They frequently substitute complete words or repeat parts of them over and over again. All of these I now hold to be by-products of the fundamental difficulties in association resulting from the confusion and reversals which operate to prevent a facile association between the visual and auditory spheres, but do not in any measure show that such association is truly defective or that it cannot be adequately established by proper methods. This conception, as will be seen, immediately takes the reading problem out of the sphere of pathologic conditions and limits it to a physiologic failure and thus to a problem of adequate training.

REINFORCEMENT OF THE ASSOCIATIVE PROCESS

Other things being equal, reinforcement of the associative process by means of a third sensory channel should secure a more adequate implantation and hence an easier association. With this general principle in mind, I have recommended the simultaneous tracing and sounding of a letter over its visual symbol. This differs to some degree from most of the previously used kinesthetic methods in that kinesthesis has been used chiefly for the purpose of aiding the visual implantation. Since, however, the aim is for greater facility of association between visual material and its auditory counterpart, it seems wise to link these together, using kinesthesis as the bond. The mechanics of this process, as carried out, is for the child to trace in script (or in the so-called manuscript writing) a written form, by which the visual is presented, and at the same time to sound the letter or word. Both the name of the letter and its phonetic equivalent should be thus linked to the visual symbol in order that the child may be taught to recall the name of the letter for purposes of oral spelling and the sound of the letter for purposes of constructive reading. The consistent motor drill of this kinesthetic method also aids markedly in written spelling, and has been used in a few cases for the correction of an isolated spelling defect.

The emotional variants, which are so frequently to be found in these children, I consider to be in large part a secondary result of the handicap rather than a causative factor. Granted an obstacle to reading progress which neither the teacher nor parent can understand, it is easy to see how a situation of extreme emotional tension for the child may arise. This emotional overloading is further fostered by the characteristically cruel remarks of other children. Another situation which frequently brings an obvious additional emotional stress is that which arises when a younger brother or sister is rapidly surpassing in reading capacity the child who is suffering from this handicap. From these emotional stresses, there may arise a variety of reactive patterns in the children, which are to be discussed elsewhere.[2] These reactions are frequently of prime importance from the standpoint of treatment, even though in our current envisagement they are not of etiologic rank. It is highly important that the child's cooperation and willingness to work be encouraged, and this can often be done only if his emotional antipathy toward a subject in which he has met with a serious obstacle is overcome.

I think it has been demonstrated, in most instances at least, that the physiologic variant which causes the reading disability can be overcome by proper training. As will be seen, this possibility of training holds a challenge to the view of inherent psychologic types. In the past one has been wont to look on certain persons as primarily visual or primarily

2. Orton and Sprague, to be published.

auditory in their mental processes, and the tendency has been to think of these as inherent patterns and to fit the training of the child for the use of that pathway which is the most facile. If, however, one can increase the facility of interchange between the visual and auditory, the logical point of attack in training should be not the most facile but rather that which shows the least facility. In the past, it has frequently been recommended that a child with a quick auditory memory, but with poor visual acquisition of words, should be prepared for a vocation in which most of his social intercourse will be by way of the auditory pathway. Today, I think, there is an open question whether training should not focus in such a child on the visual in order, so far as possible, to enrich the use of the lesser sphere and thus give him a much more rounded acquisitional capacity. The demonstration of the possibility of training in such cases also offers a strong challenge to the much looser psychologic concept of persons of the "nonverbal" type. This is particularly true of children who have an apparently quick mind, but show traces of a special disability both in reading and in the use of visually acquired material as a guide to speech. When one comes to consider such combinations of special disabilities, one is near to the problem of the feebleminded. I feel sure today that when a reading disability or a speech difficulty (particularly of the type of developmental delay in speech) or a developmental apraxia exists in a child as an isolated defect, the condition is to be looked on as potentially correctable. When, however, two or more of these defects are present in the same child, the picture, both in general and by means of the results of mental tests, is characteristically that of feeblemindedness. How far training is possible in children showing two or more of these defects cannot as yet be answered, but in one case of this nature in which the child is now under retraining, definite progress has been made in a few weeks.

ABSTRACT OF DISCUSSION

Dr. Frederick Tilney, New York: I do not know whether Dr. Orton is familiar with Sir Richard Paget's theory of the genesis of human speech. At any rate, it bears out many of the points that he has made in the retraining or training of these children. Paget believes that speech is merely a stepping up of manual symbols, of gestures from the hand, when the hand became free as an organ for performances other than those of locomotion and gradually delegated the gestural functions to the articulatory organs, the lips and tongue and the general formational system. If that is the case, one can see that Dr. Orton's suggestion of introducing kinesthetic associations in the learning of language has a definite evolutional basis because, as Dr. Mills has so often pointed out and pointed out again this morning, the actual basis of all understanding of the nervous system must be an evolutional one, and this presentation certainly seems to be in accord with the teaching of Dr. Mills.

Dr. Bernard Sachs, New York: I wish that we had a large assemblage of teachers at this meeting in order that they might have heard your reasoning regard-

ing some of the difficulties that children meet while at school, difficulties that are generally laid at the door of the children; that is, the child is supposed to be in some way deficient, whereas in a large percentage of cases the trouble is entirely with the teacher or with the method of teaching. Modern teachers pride themselves on this new method of teaching reading, a method that is dependent entirely on the sight of the entire word and not at all on any knowledge of the individual sounds that go to make up the word.

My attention was called to this subject by the fact that some years ago it so happened that a number of children were brought to my attention who were supposed to be mentally defective on account of the reading disability of which Dr. Orton spoke; on analyzing the situation, I found it was not any real defect on the part of the child but was due entirely to this defective method of teaching.

I have tried to point out in various publications to teachers that their method is faulty. The new method of teaching makes it difficult to acquire the power to read because it depends entirely on vision and does not take account of the sense of hearing. It makes the task of the child doubly difficult, and it is a wonder that any of them really learn to read efficiently. As a matter of fact they do, but many of the children find it extremely difficult.

The worst thing about this new method of teaching children to read is this, and I think Dr. Orton will agree with me in this statement: the average child who learns to read according to the method that we older people were fortunate enough to learn needs little help in meeting a new word, while a child who learns to read by sight the entire word is entirely at sea when he meets a new word. Even children who have been learning to read for several years are entirely unable to meet the simplest new word; one little fellow found "umbrella" a great stumbling block.

DR. SAMUEL T. ORTON: I am familiar with some of the points that Dr. Tilney brought up about Paget's theories of the development of speech; but I am not ready to commit myself one way or the other. I think that it is possible that Paget's views are correct as one sees an intimate relationship between gestures and speech, but I am inclined at present to look on both as a functional expression of one area the evolution of which might have occurred by either route or by both simultaneously.

With regard to the teaching method, I have found in the study of children that when orientation for direction is pretty well established, reading is acquired by these newer methods with greater speed; in other words, those children who have their directional tendencies already well established acquire reading much more rapidly, but they do not acquire the fundamental method of building words from sounds; those children who suffer from confusion of direction do not have it straightened out for them by the method of visual presentation. Until they learn to grasp the word as a whole they do not have a way of analyzing, and they are apt to manifest this defect by bizarre misspelling. For example, one small boy who read four pages for me from a book with only three errors in pronounciation in reading made thirty-eight errors in spelling from among the same words which he had just read aloud, and these were errors through failure of the visual element.

I think there is, however, one thing that we must remember, namely, that we ourselves have not offered much to educational psychologists or teachers. I think that the time has come when we have a great deal which we can offer from the field of neurology to teachers to guide their thinking, but most of present day teaching has gone forward from a psychologic point of view; in other words, through the study of functions, without any control whatsoever from the structure of the organ which they are training.

THE RELATION BETWEEN THE TOTAL BRAIN WEIGHT AND THAT OF SOME OF ITS COMPONENT PARTS IN EPILEPTIC PATIENTS*

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A good deal has been written on the relation of the total brain weight to that of various of its component parts, both in the normal person and in different varieties of dementia, but comparatively little has been recorded with respect to these relations in epilepsy. Yet the problem seems not unpromising when one considers the frequent presence of paroxysmal ataxia in this condition and the fact that a reduction in the weight of the brain below normal has been reported by several observers.[1]

The total brain weight of the cerebellum and the proportion between it and that of the cerebrum for various races have been reported by Weisbach [2] in table 1.

In table 1, we have summarized the total number of cases studied in the various races included and the average for the total brain weight, the cerebellar weight and the proportion existing between the two. In averaging this tabulation the sexes could not be satisfactorily separated, so we were obliged to calculate a single figure for both. This figure is in close agreement with that of Kappers [3] who gave 1,322 Gm. as the total weight for the brain of the male and 1,210 Gm. for that of the female, with a general average of 1,266 Gm.; it also accords with that of Parchappe,[4] 1,352 Gm. for that of the male and 1,229 for that of the female, with a general average of 1,290 Gm. These results are in

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1. Myerson, A.: A Note on the Relative Weight of the Liver and Brain in Psychoses, Taunton State Hospital Papers, J. Nerv. & Ment. Dis. **41**:444 (July) 1914. Thom, D. A.: Abnormal Relation Between Liver and Brain Weights in Forty-Two Cases of Epilepsy, Bull. Mass. Dept. Ment. Dis. **7**:123, 7, 1917-1918; J. Nerv. & Ment. Dis. **14**:422 (May) 1916. Patterson, H. A., and Weingrow, S. M.: The Relation Between Brain and Liver Weights in Epilepsy Considered from the Standpoint of Onset and Duration in About 200 Cases, Psychiat. Quart. **2**:171, 1928.

2. Weisbach, A.: Die Gewichtverhältnisse der Gehirne osterreichischen Volker, Arch. f. Anthrop. **1**:191 and 285, 1867.

3. Kappers, C. U. Ariens: Relation of Cerebellum Weight to Total Brain Weight in Human Racés and in Animals, J. Nerv. & Ment. Dis. **65**:113 (Feb.) 1927.

4. Parchappe: Recherches sur l'encéphale, sa structure, ses fonctions, Première Memoire, Paris, 1836, p. 99.

strikingly close agreement with those given by Tilney and Riley [5] in this country: 1,360 Gm. for the weight of the brain of the male and 1,230 for that of the female, with an average of 1,295 Gm.

For the weight of the cerebellum, Kappers [3] gave 137 Gm. for the male and 126.2 for the female, a general average of 131.6 Gm. Parchappe [4] gave 160 Gm. for the male and 133 for the female. His figures showed a general average of 146.5 Gm. It is interesting to note that while the observations of Kappers for cerebellar weight fell slightly below those of Weisbach, and the observations of Parchappe were somewhat above them, an average of the results of these two investigators coincided closely with that of Weisbach.[2] Moreover, the latter's figure

TABLE 1.—*Weisbach's Table for the Austro-Hungarian Population*

Nations	Number of Brains Examined	Average Total Brain Weight	Average Weight of Cerebellum	Cerebellar: Total Brain Weight Ratio
Magyars	46	1,322.86	139.74	10.56
Roumanians	13	1,326.58	142.83	10.76
Italians	40	1,301.37	139.82	10.74
Poles	11	1,320.59	140.08	10.60
Ruthenians	18	1,320.63	141.55	10.71
Slovakians	11	1,310.74	142.56	10.87
Czechs	25	1,368.31	146.28	10.69
South Slavonians	8	1,305.11	139.56	10.69
Slavonian women	14	1,174.95	129.60	11.03
Germans	46	1,314.50	142.20	10.81
German women	16	1,180.15	125.56	10.63
Total	246			
Average		1,295.07	139.07	10.73

for average cerebellar weight tallied closely with that of Tilney and Riley [5] who gave 140 Gm.

A number of writers have investigated the proportion by weight of the cerebellum to the total brain weight. Huschke [6] estimated this as 10.82 per cent, Kappers as 10.39, Rey [7] 10.84 and Tilney and Riley 10 per cent. Several investigators have also separated the percentage for the sexes. These we have averaged as follows: Boyd [8] 11.67; Parchappe [4] 11.3, and Krause [9] 11.8.

5. Tilney, F., and Riley, H. A.: The Form and Functions of the Central Nervous System, ed. 2, New York, Paul B. Hoeber, 1923, p. 683.

6. Huschke, E.: Schadel, Hirn und Seele der Menschen und der Tiere nach Alter, Geschlecht und Race, Jena, Mauke, 1854, p. 75.

7. Rey: Les poids du cervelet, du bulbe, de la protuberance et des hémisphères d'aprés les registres de Broca, Rev. anthrop. **7**:193, 1884.

8. Boyd: Tables of Weight of Human Body and Internal Organs, etc. Arranged from postmortem examinations, Tr. Roy. Soc. London **151**:262, 1861.

9. Krause: Handbuch der menschlichen Anatomie, ed. 3, 1879, vol. 3, p. 763.

Donaldson [10] recorded a table of the weight of the brain and its component parts, which was compiled by Marshall from Boyd's records (table 2).

From the data previously presented, we have accepted as a normal standard the weights in grams given in table 3.

TABLE 2.—*The Weight of the Encephalon and Its Subdivisions in Sane Persons, the Records Being Arranged According to Sex, Age and Stature*

(From Marshall's tables based on Boyd's records)

Males					Females				
Ages	Encephalon	Cerebrum	Cerebellum	Stem	Ages	Encephalon	Cerebrum	Cerebellum	Stem
	Stature 175 cm. and upward					Stature 163 cm. and upward			
20-40	1,409	1,232	149	28	20-40	1,265	1,108	134	23
41-70	1,363	1,192	144	27	41-70	1,209	1,055	131	23
71-90	1,330	1,167	137	26	71-90	1,166	1,012	130	24
	Stature 172 to 167 cm.					Stature 160 to 155 cm.			
20-40	1,360	1,188	144	28	20-40	1,218	1,055	137	26
41-70	1,335	1,164	144	27	41-70	1,212	1,055	131	24
71-90	1,305	1,135	142	28	71-90	1,121	969	128	24
	Stature 164 cm. and under					Stature 172 cm. and under			
20-40	1,331	1,168	138	25	20-40	1,199	1,045	130	24
41-70	1,297	1,123	139	25	41-70	1,205	1,051	129	25
71-90	1,251	1,095	131	25	71-90	1,122	974	123	25
Average....	1,331	1,163	140	26.5		1,190	1,036	130	24.4

	Males	Females
Average weight of cerebral hemisphere	581.5	515

	Encephalon	Cerebrum	Cerebellum	Stem
Both sexes	1,210.5	548.3	135	25.5

TABLE 3.—*Normal Standard of Weights in Grams*

	Male	Female	Both Sexes
Average total brain weight	1,340	1,225	1,286.5
Average weight of the cerebrum	1,163	1,036	1,099.5
Average weight of one hemisphere	581.5	515	548.3
Average cerebellar weight	148.5	129.6	139.1
Average weight of the brain stem	26.5	24.4	25.5
Average cerebellar to total brain-weight ratio	11.10	11.14	11.10

The data thus far presented deal with normal observations in various persons and races. There are also on record some observations for the structures and ratio just considered, and also for the relative weight of the two hemispheres, in various nervous and mental disorders, which it may be interesting to contrast with the results obtained in epilepsy. In 1879, Crichton-Browne [11] made observations on the weight of the brain and its component parts in the insane, collecting his material from

10. Donaldson, H. H.: The Growth of the Brain, New York, Charles Scribner's Sons, 1897, p. 97.

11. Crichton-Browne: On the Weight of the Brain and Its Component Parts in the Insane, Brain **1**:504, 1879.

400 postmortem examinations on inmates of various ages at the West Riding Asylum. His results are shown in table 4.

The ratio of the cerebellar weight to the total brain weight and the cerebral-cerebellar quotient (to be described later) were not in the author's original table, but have been added by us from figures which he furnished. Crichton-Browne also made the statement that the right hemisphere is heavier than the left in both sexes in all decades. Thurnham's [12] results also show that the right hemisphere is heavier than the left. This observation is in conflict with that of Boyd,[8] who reported that, in a study of 528 lunatics and 200 paupers, he found that the weight of the left hemisphere exceeded that of the right by 3.5 Gm.

Reichardt [13] has studied the weight of the human cerebellum in health and in disease conditions in more than 100 cases. The abnormal conditions embraced in his investigation included chiefly functional and organic disturbances of the nervous system. He approached the problem from the standpoint of the cerebrocerebellar quotient and classified

TABLE 4.—*Crichton-Browne's Observations at West Riding Asylum*

Sex	Number Cases	Total Brain Weight	Right Hemisphere	Left Hemisphere	Weight of Cerebellum	Cerebellar to Total Brain Weight	Cerebral Cerebellar Ratio
Male.....	244	1,334.7	580.7	577.0	151.4	11.35%	13.07
Female.....	156	1,198.5	521.1	519.0	135.7	12.63%	14.55
Total.....	400	1,281.6	557.4	554.4	145.3	11.99%	13.81

his material with reference to whether it fell above, within or below the normal limits for this quotient, which is obtained by dividing the weight of the hemispheres by that of the cerebellum. He has presented his data in a series of a dozen carefully worked out tables which we have summarized in table 5.

It will be noted from table 5 that the average total brain weight falls below the accepted normal except in cerebral tumor, senile dementia and functional psychoses, in both the latter without atrophy (all in males). The weight of the cerebral hemispheres also falls below normal in all these instances except in cases of cerebral tumor (male) and functional psychoses (female). It may be seen from the table that the cerebrocerebellar quotient in these conditions is variable, as it may fall both in the normal group and in one of the abnormal groups for the same conditions, as is well illustrated by the quotient in senile dementia. Reichardt [13] derived his cerebrocerebellar quotient by dividing the cerebral by the cerebellar weight. It naturally follows from its derivation

12. Thurnham, quoted by Crichton-Browne (footnote 11).

13. Reichardt, M.: Ueber das Gewicht des menschlichen Kleinhirnes im gesunden und kranken Zustände, Allg. Ztschr. f. Psychiat. **63**:183, 1906.

that the cerebrocerebellar quotient will be high in any condition which increases the weight of the hemicerebrums or decreases the weight of the cerebellum and, conversely, it will be low when an inverse relationship obtains between these portions of the brain; it will remain normal in those conditions, such as the functional psychoses, in which the weights of both the hemispheres and the cerebellum remain unaltered. From Reichardt's data we have computed the relation of the cerebellum to the total brain weight in his cases and find that this proportion

TABLE 5.—*Summary of Reichardt's Data*

Disease or Condition	Sex	Number of Cases	Total Brain Weight	Average Weight of Cerebral Hemispheres		Average Cerebellar Weights	Average Cerebrocerebellar Quotient	Average Cerebellar to Total Brain Weight Ratios
				Right	Left			
Cerebrocerebellar Quotient Above Normal								
Tumor of cerebral hemispheres	Male	4	1,427	561	611	133	8.9	0.3
	Female	4	1,204	536	507	119	8.7	9.9
Cerebellar atrophy	Male	2	1,310	535	530	120	9.3	9.2
	Female	2	945	440	435	88	9.2	9.3
	Unclassified	1	960	400	410	90	9.0	9.0
Congenital cerebellar atrophy	Male	2	1,200	...	...	108	9.6	9.0
Cerebrocerebellar Quotient Normal								
Dementia senilis without atrophy of the brain	Male	2	1,175	475	480	110	8.7	9.4
	Female	6	1,084	461	442	116	7.8	10.7
Functional psychoses	Male	14	1,342	548	541	144	8.3	10.7
	Female	10	1,208	520	519	131	7.7	10.9
	Unclassified	2	1,265	527.5	530	135	7.9	10.7
Paralysis with atrophy of the brain	Male	12	1,075	450	429.5	120	7.4	11.1
	Female	10	998	428.5	425.5	114	7.3	11.4
Paralysis without atrophy of the brain	Male	5	1,341	511	508	155	7.1	11.5
	Female	2	1,075	485	475	115	7.9	10.7
Cerebrocerebellar Quotient Below Normal								
Paralysis with atrophy of the brain	Male	12	1,091	427	423	144	6.1	14.1
	Female	10	1,000	378	371	135	5.7	13.5
Dementia senilis	Female	4	953	379	372	126	6.1	13.2
Microcephaly	Unclassified	4	871	344.6	392	136	5.0	15.6
Total		108						

increases as the cerebrocerebellar quotient decreases and vice versa, as might be expected. In other words, when the cerebrocerebellar quotient is normal the cerebellar: total brain weight proportion also falls within normal limits, but when the former is high the latter is low and conversely. Among the material described in table 5 were a number of conditions with which Reichardt found epilepsy associated. As we are particularly interested in these instances, we have collected them for more careful scrutiny and present them in table 6.

As in the preceding instance, we have arranged table 6 to show which cases fall within the normal limit for the cerebrocerebellar quotient and which fall either above or below. We have again also added a supplement indicating the proportion of the weight of the cerebellum to the total brain weight. With the exception of the instances of microcephaly

and atrophy (paralysis), the total brain weight in the majority of these cases is normal. The same is true of the weights of each hemisphere. The weight of the cerebellum is also fairly close to the normal in the majority of instances with the exception of a case of paralysis with atrophy and one with congenital cerebellar atrophy. In 50 per cent of the cases the cerebrocerebellar quotient falls within normal limits, while in 25 per cent it falls above and in 25 per cent below. This also applies to the cerebellar : total brain weight ratio. The data are of interest both because they are illuminating in regard to the weight of the brain and some of its component parts in certain pathologic conditions and because they provide a basis of comparison for our own observations.

TABLE 6.—*Reichardt's Epileptic Cases*

Cerebro-cerebellar Quotient	Number of Cases of Epilepsy	Associated Condition	Total Brain Weight	Cerebral Hemisphere		Cerebellar Weight	Cerebrocerebellar Quotient	Cerebellar to Total Brain Weight Quotient per Cent
				Right	Left			
Above normal	1	Hydrocephalus	1,400	...	...	135	9.0	9.6
	1	Congenital cerebellar atrophy	1,300	...	...	115	9.5	8.6
Normal	1	Functional psychoses	1,290	550	550	130	8.5	10.0
	1	Functional psychoses	1,300	552	508	140	7.6	10.7
	1	Functional psychoses	1,126	...	...	125	7.4	11.1
	1	Paralysis	1,005	385	428	106	7.7	10.5
Below normal	1	Microcephaly	760	230	370	130	4.5	17.1
	1	Idiocy, microcephaly	665	...	...	130	4.0	19.6
Total...	8							

For the purposes of this investigation we chose specimens of brain which had been secured at autopsy from essential epileptic patients of both sexes, all of whom had had grand mal attacks and some of whom also had had petit mal seizures in addition. These had been preserved in formaldehyde for variable periods. All, however, were sufficiently hardened so that they could be sectioned satisfactorily. The technic of sectioning employed was as follows:

TECHNIC

The specimen was removed from formaldehyde and dried on blotting paper. A cut was made severing the medulla from the spinal cord just below the inferior olivary bodies. Then the brain was weighed in toto. Next the cerebral peduncles were severed in close proximity to the hemispheres and the pineal body. The hemispheres were then separated by a section passing through the great fissure, the corpus callosum and the optic chiasm and between the corpora mammillaria. Next, each hemisphere was drained of its fluid content, dried and weighed separately. The cerebellum was then freed by disconnecting the cerebellar peduncles just at the point of their emergence from the organ. The weight of the cerebellum was thus obtained. Finally the midbrain, pons and medulla were weighed ensemble. By means of these procedures, we secured the following results. After completing

the section the severed parts were collected and weighed in toto. Subtraction of this weight from the original total brain weight gave the weight of the fluid lost. To determine any change in weight which might have been due to the hardening and preservative processes, we compared the average weight of this group of specimens of brain, as secured at autopsy, with the average weight for the series obtained at the time of section. This showed the average loss of weight for the specimen of brain of the male to be 138 Gm., or 10.5 per cent; that for specimens of brain of the female 89 Gm., or 7.7 per cent. Applying these coefficients of shrinkage and assuming the loss in weight to be uniform in its distribution, corrections were obtained which gave the average weights of the total brain, each hemisphere, the cerebellum and the brain stem in the fresh state.

COMMENT

From tables 7 and 8 it may be seen that in our cases the average total brain weight falls appreciably below our adopted normal for both sexes. This is also true for the weight of the hemispheres in both sexes. But in our male epileptic patients the right hemisphere is somewhat (3.9 Gm.) heavier than the left, whereas in our female epileptic patients we find the left hemisphere to be 3.3 Gm. heavier than the right. These patients are in keeping with the observations of Braune,[14] who claimed that the right hemisphere dominates about as often as the left with an average difference of about 5 Gm. It is probable that no significance attaches to the variation of the relative preponderance in weight of the hemispheres in the two sexes, since Tilney and Riley [5] call attention to the fact that the two hemispheres of the brain, although hardly ever of the same weight, do not show a constant difference, and that there is not any evidence to show that the right hemisphere is heavier than the left in right-handed persons.

The weight of the cerebellum also falls below normal in both the male and the female specimens studied. In the case of what Boyd [8] designated as the brain stem—the midbrain, including the corpora quadrigemina, the pons and the afterbrain or bulb—our results are slightly above normal for both sexes (0.5 above the normal figure given by Boyd [8] for males and 1.4 above that given by him for females). This may, perhaps, account for relative facility of operation of the vegetative functions in these persons, even when the condition is complicated by amentia.

The cerebrocerebellar quotient, determined according to Reichardt, for our cases falls within the normal limits given by this author for both sexes. This, no doubt, is due to the concurrent reduction in weight observed in these two portions of the brain.

With regard to the ratio of the weight of the cerebellum to the total brain weight, we find, on comparing our results with the figures derived

14. Braune, C. W.: An Atlas of Topographical Anatomy After Plane Sections of Frozen Bodies, translated by E. Bellamy, Philadelphia, 1877.

TABLE 7.—*Brain and Component Parts of Female Patients with Idiopathic Epilepsy*

Autopsy Number	Total Brain Weight	Without Fluid	Weight of Fluid	Weight of Right Hemisphere	Weight of Left Hemisphere	Weight of Cerebellum	Weight of Midbrain, Pons and Medulla	Cerebro-cerebellar Ratio	Cerebellar to Total Brain Weight Ratio
1224	1,074	1,074.0	0.0	467.0	472.0	112.0	23.0	8.38	10.4
1373	941	940.0	1.0	409.0	407.0	101.0	23.0	8.07	10.7
1355	1,217	1,213.0	4.0	528.0	542.0	118.0	25.0	9.06	9.6
1360	978	978.0	0.0	420.0	416.0	120.0	22.0	6.96	12.2
1384	972	970.5	1.5	423.0	425.0	102.0	19.5	8.31	10.4
1353	1,058	1,058.0	0.0	468.0	448.0	116.0	26.0	7.89	10.7
1378	1,079	1,079.0	0.0	469.0	460.0	126.0	24.0	7.37	11.6
1354	1,238	1,238.0	0.0	527.0	544.0	139.0	28.0	7.70	11.2
1491	1,058	1,047.0	11.0	437.0	467.0	121.0	24.0	7.47	11.4
1495	1,016	1,003.0	13.0	448.0	413.0	119.0	23.0	7.23	11.7
1484	982	978.0	4.0	432.0	427.0	100.0	19.0	8.59	10.1
1267	1,170	1,168.0	2.0	508.0	504.0	131.5	24.5	7.72	11.2
1366	907	906.5	1.5	392.0	396.0	91.5	27.0	8.65	10.08
1286	939	934.0	5.0	389.0	413.0	109.0	23.0	7.35	11.6
1208	1,192	1,191.0	1.0	522.0	524.0	115.0	30.0	9.09	9.6
....	904	890.5	13.5	374.0	380.0	112.0	24.5	6.73	12.2
1400	1,017	1,014.0	3.0	444.0	439.0	108.0	23.0	8.17	10.6
1389	1,049	1,049.0	0.0	456.0	436.0	129.0	28.0	6.91	12.2
1362	1,174	1,172.5	1.5	464.0	565.0	116.5	27.0	8.07	9.9
1368	1,025	1,022.0	3.0	446.0	430.0	124.0	24.0	7.08	12.0
1389	843	841.5	1.5	363.5	366.5	91.0	20.5	8.62	10.7
1677	1,277	1,275.5	1.5	563.5	562.0	125.0	25.0	9.00	9.8
1351	1,065	1,064.0	1.0	463.0	466.0	114.0	21.0	8.14	10.7
1367	1,179	1,179.0	0.0	516.0	512.0	128.0	23.0	8.80	12.2
Average	1,056	1,053.0	4.1	455.0	458.0	115.3	24.0	7.94	10.9
Corrected Average	1,137.3			490.0	493.3	124.2	25.8		

TABLE 8.—*Brain and Component Parts of Male Patients with Idiopathic Epilepsy*

Autopsy Number	Total Brain Weight	Without Fluid	Weight of Fluid	Weight of Right Hemisphere	Weight of Left Hemisphere	Weight of Cerebellum	Weight of Midbrain, Pons and Medulla	Cerebro-cerebellar Ratio	Cerebellar to Total Brain Weight Ratio
1385	885.0	881.0	1.0	386.0	384.0	96.0	18.0	8.02	10.8
1416	1,112.0	1,111.0	1.0	442.0	509.0	134.0	26.0	7.09	12.0
1470	1,217.0	1,216.0	1.0	534.0	535.0	120.0	27.0	8.90	9.8
1477	1,189.0	1,187.0	2.0	515.0	527.0	121.0	24.0	8.60	10.09
1393	1,219.0	1,219.0	0.0	528.0	530.0	134.0	27.0	7.80	10.9
1469	1,313.0	1,301.0	12.0	575.0	571.0	127.0	23.0	9.02	9.6
1264	1,163.0	1,163.0	0.0	516.0	514.0	106.0	27.0	9.70	9.1
1372	1,167.0	1,167.0	0.0	506.0	517.0	119.0	25.0	8.50	10.1
1356	1,257.0	1,245.0	12.0	516.0	571.0	131.0	27.0	8.30	10.4
1520	1,348.0	1,335.0	13.0	590.0	594.0	124.0	27.0	9.50	9.2
1490	1,272.0	1,242.0	10.0	563.0	545.0	112.0	22.0	9.08	8.9
1536	1,181.0	1,165.0	16.0	535.0	514.0	106.0	20.0	9.80	8.9
1489	749.0	735.0	14.0	394.0	243.0	82.0	16.0	7.70	10.9
1069	1,407.0	1,394.0	13.0	615.0	617.0	132.5	29.5	9.30	9.4
1487	882.0	876.5	5.5	378.0	388.0	91.5	19.0	8.40	10.3
1273	1,302.0	1,294.5	7.5	570.0	565.0	130.5	29.0	8.70	10.02
1266	1,250.0	1,243.5	6.5	535.5	541.0	138.0	29.0	7.80	11.0
1263	999.0	981.0	18.0	439.5	432.0	100.0	19.5	8.70	10.01
1225	1,053.0	1,053.0	0.0	462.0	457.0	113.0	21.0	8.10	10.07
1279	1,293.0	1,287.0	6.0	553.0	572.0	135.0	27.0	8.30	10.4
1260	1,226.0	1,211.5	15.0	538.0	528.0	131.0	24.5	8.10	10.6
1503	1,099.0	1,097.5	1.5	492.0	499.5	82.5	23.5	12.00	7.5
....	1,186.5	1,178.5	7.5	518.5	502.0	131.0	27.0	7.70	11.0
1172	1,184.0	1,181.5	2.5	513.0	519.0	119.5	30.0	8.60	10.0
1448	1,324.0	1,323.5	0.5	595.0	555.0	139.0	34.5	8.20	10.4
1239	1,080.0	1,080.0	0.0	584.0	569.0	103.0	24.0	9.20	9.5
Average	1,166.8	1,160.0	7.8	511.2	507.6	117.6	25.0	8.27	9.64
Corrected Average	1,282.6	.....	...	562.3	558.4	129.4	27.5		

from the authors previously cited, that this proportion is practically normal for the female group, but falls slightly below normal (1.46 per cent) for the male series.

We can now contrast our results with the results in pathologic conditions reported by other writers. When our results are compared with those reported by Crichton-Browne for the psychoses, it will be noted that the total brain weight, the weight for each hemisphere respectively and the weight of the cerebellum in our cases fall below the weight given by this author for each sex in every instance mentioned. Our figures for the proportion of the weight of the cerebellum to the total brain weight and the cerebrocerebellar ratio are also considerably below his. When our observations are contrasted with those of Reichardt, we find that in his series the average total brain weight falls below his figures except for cerebral tumor (male), cerebellar atrophy (male), functional psychoses (both sexes) and paralysis without atrophy of the brain (male). With respect to the hemispheres, this author's averages fall below ours except in cerebral tumor (both hemispheres and both sexes) and functional psychoses (both hemispheres, male). But in the case of the cerebellum, his averages fall below ours only in cerebellar atrophy (both sexes), senile dementia without atrophy of the brain (both sexes) and paralysis with atrophy of the brain (both sexes). Our cerebrocerebellar quotient falls within the limits of what he regarded as normal and is therefore higher than in those instances which he grouped as subnormal in this respect and lower than those which he regarded as above normal. The same applies to the ratio of the weight of the cerebellum to the total brain weight, but in an inverse order. On narrowing our scrutiny to his cases of epilepsy alone, it may readily be observed that Reichardt's observations in this condition tended in general to be appreciably higher than our results, as may be seen from table 6, except in microcephaly and paralysis. Except in the latter condition, the cerebellar weight observed by Reichardt also tended to exceed ours. It must be borne in mind, however, that his series of cases is small (only eight in number) and that in it the epilepsy accompanies other concurrent conditions.

CONCLUSIONS

1. The average total brain weight falls below normal for both sexes.

2. In our male epileptic patients the right hemisphere tends to be somewhat heavier than the left; in female epileptic patients, the converse relation obtains.

3. This variation in the relative preponderance of the weight of the hemispheres in the two sexes is probably not significant.

4. The average weight of the cerebellum falls below normal in both sexes.

5. The average weight of the brain stem is slightly above normal for both sexes.

6. The cerebrocerebellar quotient determined according to Reichardt falls within normal limits in our cases for both sexes.

7. In epilepsy, the weights of the hemispheres and of the cerebellum tend to be correspondingly reduced.

8. The ratio of the weight of the cerebellum to the total brain weight is practically normal for the female group, but falls slightly below normal in the male group.

9. In our series, the average total brain weight in both sexes falls below that reported for dementia and amentia except in instances of microcephaly, cerebellar atrophy and dementia senilis and paralysis.

10. The weight of the respective hemispheres for both sexes in our series also falls below that observed in the psychoses with the exceptions already noted and in some cases of functional psychoses.

11. The average weight of the cerebellum also falls below that reported for the psychoses, except in some cases of atrophy and senile dementia.

12. In the majority of instances the ratio of the weight of the cerebellum to the total brain weight tends to be higher in other nervous and mental abnormalities than in our cases of epilepsy.

13. This is also true of the cerebrocerebellar quotient of Reichardt.

EFFECT OF STORAGE (ICEBOX) ON CELL COUNT IN PATHOLOGIC CEREBROSPINAL FLUID*

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My object in this paper is to determine whether the spinal fluid has any deteriorating effect on the cells contained therein after it has been stored for a number of hours. The practical importance of such a study is apparent when a spinal fluid must be transported to a central laboratory, at such a distance as to delay considerably the cell count, and thus possibly result in a faulty count of the number of cells and perhaps an error in diagnosis. The importance of an immediate cell count in the spinal fluid is generally stressed by clinicians.

There is little reference in the recent literature to the effect of storage on the cells in the cerebrospinal fluid. Levinson,[1] in his special book on "Cerebrospinal Fluid in Health and Disease," does not mention it. Greenfield and Carmichael,[2] in their recent book covering almost the entire field of spinal fluid in clinical diagnosis, stated that, "It has long been known that cells tend to disappear from the fluid somewhat rapidly when it is kept at room temperature even under sterile conditions. Kaffka found that the plasma cells and polymorphonuclears disappeared much earlier than the lymphocytes." Campbell, Davidoff and Grabfield,[3] in investigating the effect of storage on the cell count both at icebox and room temperature, stated, "We placed a series of fluids in the icebox and counted them daily. Much to our surprise these counts remained unchanged seven to eight days." These investigators finally concluded from their study that "if nonpurulent fluids be preserved at room temperature or in the icebox and well shaken before counting, the cell count will be correct for at least five days after withdrawal." The other constituents of the spinal fluid, namely, the protein and dextrose content, the substances responsible for the colloidal gold curves and the Wassermann reaction, presumably remain undiminished for a reasonable time, provided the fluid has been protected from evaporation.

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* Submitted for publication, June 4, 1928.

* Published with the permission of the Medical Director of the United States Veterans' Bureau, who assumes no responsibility for the opinions expressed or the conclusions drawn by the writer.

1. Levinson, Abraham: Cerebrospinal Fluid in Health and Disease, ed. 2, St. Louis, C. V. Mosby Company, 1923.

2. Greenfield, Goodwin J., and Carmichael, Arnold E.: The Cerebrospinal Fluid in Clinical Diagnosis, New York, The Macmillan Company, 1925, p. 209.

3. Campbell, C. J.; Davidoff, L. M., and Grabfield, G. P.: Boston M. & S. J. **185**:657 (Dec. 1) 1921.

Those who stress the importance of an immediate cell count believe that the spinal fluid itself does not exert a deteriorating influence on the cells, but rather that a certain number of cells in a given volume of fluid after standing gravitate to the bottom of the container and remain adherent to the tube. This contention would hold true if the fluid contained a great number of cells, in which case, sooner or later, the cells would gravitate to the bottom of the tube in proportion to their numbers and the volume of fluid in which they happened to be suspended. This phenomenon takes place in cloudy or hazy fluids especially.

METHOD OF PROCEDURE

The cells were counted each day for a number of days after the immediate and initial count was made and continued until a negative or practically negative count was obtained. The removal of a small portion of fluid and the storage of this portion for daily counts were found to give inconsistent results in practical application, though theoretically one portion of a given fluid should not vary in cell content from any other portion of the same fluid, provided such volumes were removed after the fluid had been thoroughly mixed. The procedure followed in this investigation was that of using the entire volume of fluid obtained by lumbar puncture (about from 7 to 8 cm.) and of stirring it thoroughly before each count was made. All the fluids used in this investigation were absolutely clear and were obtained from patients with neurosyphilis.

The accompanying charts show the effect of icebox temperature on fifteen spinal fluids, from which it is apparent that there is a gradual decline in the number of cells from day to day. While a few of the fluids showed a temporary fluctuation in comparison with the initial count, the general trend was toward a loss. The loss is apparently not due, as commonly believed, to the physical phenomenon of gravitation to the bottom of the tube, but rather to an actual destructive effect of the menstruum. The microscopic appearance of the cells after storage is that of shadows or faint rings indicating the outline of the cell in which the nuclear substance has undergone some lytic effect and thus become difficult of microscopic detection. After longer storage the entire cell is disintegrated and a negative count is obtained. I am not prepared to state what agent is responsible for this effect. In all probability an alteration of the reaction of the fluid takes place, though icebox temperature, as a rule, prevents decided changes in reaction in other body fluids when similarly stored.

While there is undoubtedly a gradual loss of cells from day to day, the clinical significance of the count is not impaired during the first twenty-four hours' storage. This fact is readily observed in table 1, which shows the initial immediate count and the subsequent daily counts per 3.2 cc., the Fuchs-Rosenthal counting chamber being used. Table 2 gives the results of dividing by three to reduce the actual count to cells per cubic millimeter. When this count is compared from day to day,

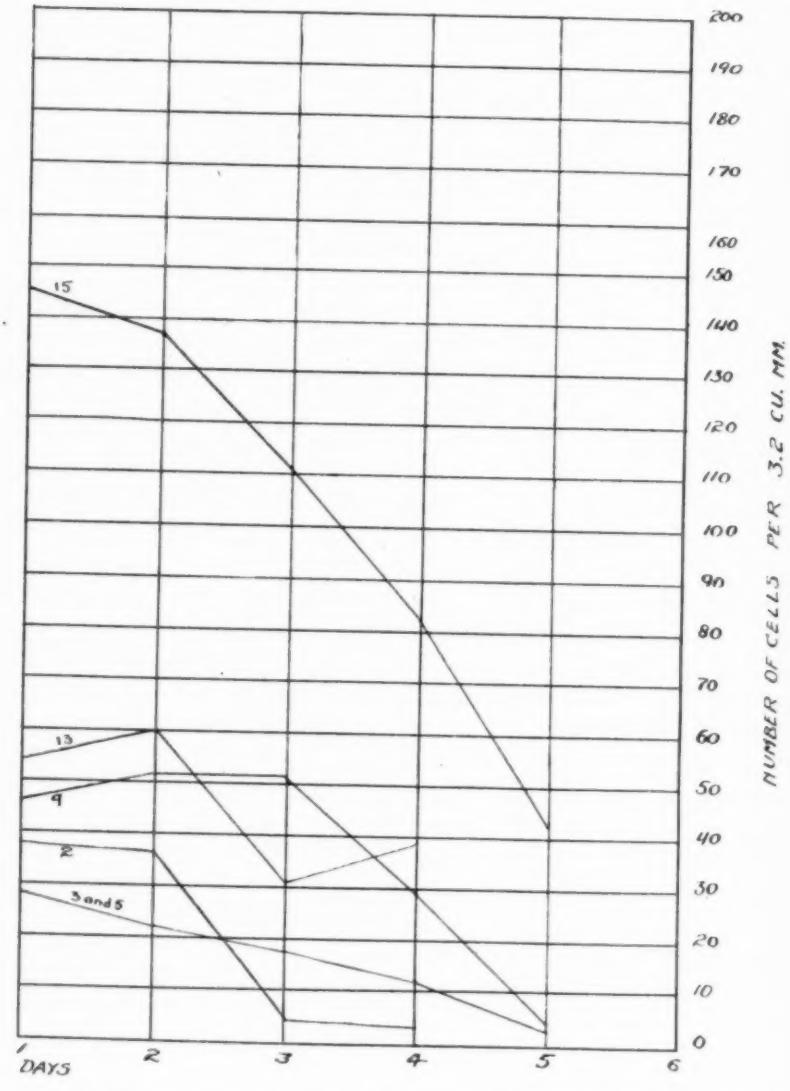

Chart 1.—Daily count of fluids, with initial counts of 20 cells per 3.2 cubic millimeters and over.

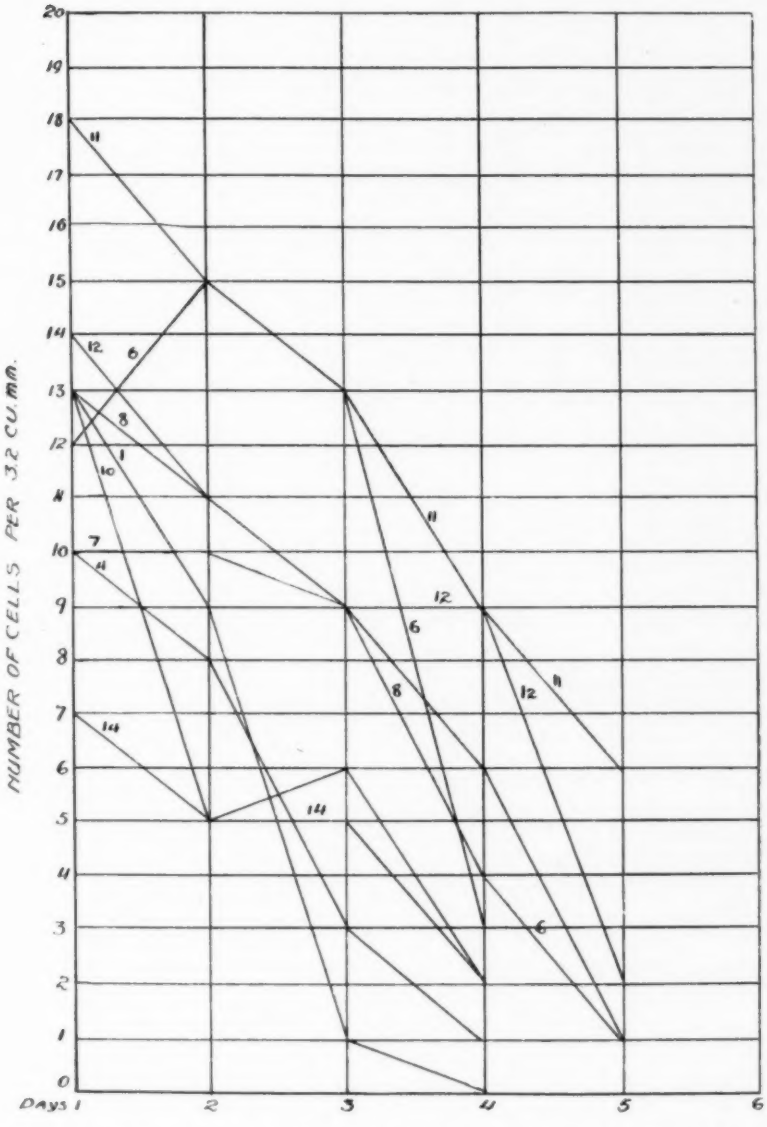

Chart 2.—Daily count of fluids, with initial count of less than 20 cells per 3.2 cubic millimeters.

TABLE 1.—*Daily Counts of Cells in 3.2 Cubic Millimeters of Spinal Fluid*

Spinal Fluid Number	Initial Count	Second Day	Third Day	Fourth Day	Fifth Day
1	13	9	1	0	..
2	37	36	4	3	..
3	28	22	18	12	3
4	10	8	3	1	..
5	28	22	18	12	3
6	12	15	13	3	3
7	10	10	9	6	1
8	13	11	9	4	1
9	46	51	51	29	6
10	13	5	6	2	..
11	18	15	13	9	6
12	14	11	9	9	2
13	54	60	31	39	..
14	7	5	5	2	..
15	145	137	112	82	43

TABLE 2.—*Daily Counts Reduced to Cells Per Cubic Millimeter*

Spinal Fluid Number	Initial Count	Second Day	Third Day	Fourth Day	Fifth Day
1	4	3	0	0	..
2	12	12	1	1	..
3	9	8	6	4	1
4	3	3	1	0	..
5	9	7	6	4	1
6	4	5	4	1	1
7	3	3	3	2	0
8	4	4	3	1	0
9	15	17	17	10	2
10	4	2	2	0	..
11	6	5	4	3	2
12	5	4	3	3	1
13	18	20	10	13	..
14	2	2	2	1	..
15	45	46	37	27	14

TABLE 3.—*Clinical Significance of Loss of Cells in Pathologic Spinal Fluid After Twenty-Four Hours' Storage at Icebox Temperature*

Effect of Storage	Number of Fluids	Clinical Significance
Loss of one cell	4	Unaltered
Loss of two cells	2	Unaltered
No loss of cells	6	Unaltered
Fluctuation without loss of cells	3	Unaltered
Total number of fluids	15	

TABLE 4.—*Loss of Cells Per 3.2 Cubic Millimeters of Spinal Fluid After Twenty-Four Hours' Storage in Icebox*

Spinal Fluid Number	Initial Cell Count 3.2 C.Mm.	After 24 Hours Storage	Number of Cells Lost	Percentage of Loss
1	13	9	4	31
2	37	36	1	2
3	28	22	6	21
4	10	8	2	20
5	28	22	6	21
6	12	15	plus 3	..
7	10	10	0	—
8	13	11	2	15
9	46	51	plus 5	..
10	13	5	8	61
11	18	15	3	16
12	14	11	3	21
13	54	60	plus 6	..
14	7	5	2	28
15	145	137	8	5

it is seen that the clinical significance is not altered during twenty-four hours' storage, while in some of the fluids forty-eight hours' standing at icebox temperature does not appear to invalidate the count.

It is evident from table 3 that the diagnostic significance has not been altered in any of the fifteen fluids since the loss of cells due to twenty-four hours' storage would not alter the diagnosis, assuming the number of cells permissible in a normal fluid to be from 5 to 6 per cubic millimeter. My personal observation of a large number of normal fluids would place the normal count at from 1 to 4 per cubic millimeter.

An analysis of table 4 shows that in a volume of spinal fluid amounting to 3.2 cubic millimeters the loss ranged from 2 per cent in fluid 2 to 61 per cent in fluid 10, while in fluids 6, 9 and 13, the cells were greater in number than on the initial count. This fluctuation is within the experimental error and may be accounted for either by the fact that the fluid was imperfectly mixed on initial count or by an adverse arrangement of the cells on the ruled space of the counting chamber.

CONCLUSIONS

1. In a study of the effect of storage on the cell count in fifteen spinal fluids kept at icebox temperature (about 8 C.), a general tendency for the cells to diminish gradually from day to day was found. The loss is apparently due to the lytic effect of the spinal fluid itself, as was evidenced by microscopic study.

2. Twenty-four hours' storage at icebox temperature does not invalidate the clinical significance of the cell count.

THE BROMIDE TREATMENT FOR EPILEPSY IN THE DISPENSARY*

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The most widely accepted treatment for epilepsy in this country is the control of the convulsions by phenobarbital, which checks the attacks well; but with sudden cessations the convulsions recur immediately; status epilepticus may follow, and not infrequently death occurs. I have seen this in several patients who had taken phenobarbital irregularly. It is therefore desirable to discuss the conditions under which other remedies, such as bromide, may still be used.

Bromide was introduced by Locock (1853). Through Brown-Séquard and Voisin, it attained the dominant position in the treatment for epilepsy. With the treatment the attacks (grand mal, petit mal and migraine) were suppressed, and a transition from the epileptic character to the normal was induced. Bromide was administered in high doses (from 15 to 20 Gm.) and rather blindly, as the actual facts of its influence were unknown. On the suggestion of the physiologist Richet, Toulouse gave a salt-free diet to epileptic persons. In 1899, both reported that a diet containing little chloride increases the effect of bromide. As a result of their reports, Laudenheimer (1901) carefully studied the metabolism and was able to show that bromide, which is introduced in a bromide-free organism, is not excreted at once. It will be retained and will accumulate for weeks until a deposit is formed which varies from person to person. An equilibrium between intake and output must be established. With polyuria there is an increase in excretion, and a sufficient deposit cannot be formed, even with increased medication with bromide. The therapeutic (antiepileptic) effect depends more on the deposit than on the daily intake. This varies individually. Therefore, the dosage which would lead to suppression of epileptic attacks in different persons varies greatly. Increased intake of sodium chloride diminishes the deposit of bromide. The bromide is replaced by chloride. Laudenheimer pointed out further that one gets retention of bromide and intoxication more easily in anemic and cachectic conditions, i. e., in cases in which there is a diminished sodium chloride content in the body fluids. Persons with intoxication must therefore be treated with large doses of sodium chloride, diuretics and digitalis.

The next step was taken by Ulrich (1910), who began to determine the amount of the retained sodium bromide, thus regulating the bromide-

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chloride equilibrium according to the individual case. His followers also pointed out that it is not possible to give a salt-free diet for any length of time without serious hazard.

In 1912, Hauptmann introduced phenobarbital in the treatment for epilepsy. The literature contains a large number of reports on results from its use which can today be summarized critically. Phenobarbital has a good influence on convulsions in persons with idiopathic epilepsy but little effect in symptomatic attacks, such as those in syphilis of the brain. Some authors obtained especially good results in petit mal attacks, while others observed little effect in these cases. Cases are also described in which it seems to cause the convulsions to occur less frequently and with longer intervals, but with a tendency to accumulate. Similar observations are occasionally made when bromide is used. Phenobarbital is considered anticonvulsive but not anti-epileptic. It checks the convulsions but cannot cure the patient or clear up the mental symptoms. Contradictory observations were made on elderly patients who had been under the influence of bromide and in whom clearing up of the condition was probably due to the passing of the dulness caused by the bromide after cessation of administration of the drug. Bromide, on the other hand, has an influence on the whole epileptic picture. The attacks as well as the mental symptoms clear up. There does not seem to be a diminution of the effect of phenobarbital with long use, and one does not therefore need to increase the dosage. It is wise to give small doses (0.1 Gm. [1½ grains] twice a day). It is useless to increase the dosage beyond 0.1 Gm. three times a day, as it fails to be more efficacious. These small doses practically eliminate the serious toxic dangers, such as hemorrhagic nephritis, caused by the administration of phenobarbital. Less dangerous toxic symptoms such as sleepiness, dizziness, scarlet fever or measles-like exanthems with diarrhea, edema and ulcers of the throat, are observed in some persons and clear up rapidly after the drug is withdrawn.

In the modern treatment with drugs, a combination of phenobarbital and bromide with a modified Toulouse-Richet diet is frequently prescribed. Ulrich gave bromide in soup tablets which contained condiments and sodium bromide in the place of table salt. Dissolved in hot water, these tablets make a tasty broth. Soup always contains a great part of the chloride of the meals of people who eat soup, and only few patients willingly accept salt-free soup. Since the low salt diet has been introduced, efforts have been made to produce more tasty food with the help of the bromide. Balint gave patients bromide bread, but this was soon given up. Ulrich used the first successful combination. It is not wise to put bromide into the food in the hope that it will replace the taste of salt. Patients soon tire of it. They prefer to take the bromide as a medicine and usually become accustomed to a diet

containing little salt. Potassium bromide was given frequently but in recent years has been replaced by sodium bromide. The potassium is said occasionally to have a bad influence on the heart. The sodium salt contains a higher percentage of bromide than the potassium derivative. Organic bromide compounds do not have a good effect on persons with epilepsy. Combinations of different bromide compounds are not more efficacious.

Symptoms of slight bromide intoxication may occur, but they do not call for a change in the dosage. One can distinguish a simple intoxication and a delirious reaction, without a sharp borderline. Delirious reactions (dreamlike hallucinatory states with marked fear and often manic features) should not occur in the course of the treatment, while simple intoxication can be seen frequently. Outstanding features are apathy, dulness and physical symptoms (poor appetite, furred tongue and bad odor of the breath, constipation, marked sleepiness, thick speech, ataxic gait, and skin reactions like acne or ulcers). These symptoms develop gradually, and their appearance does not indicate changing the dosage. I add to the diet a few grams of salt which one can have ready in capsules containing 1 Gm. (Ulrich). This change in the doses of salt will not diminish the influence of the bromide, but the toxic symptoms disappear rapidly. Acne caused by bromide usually clears up with the administration of arsenic. From 4 to 6 drops of solution of potassium arsenite (Fowler's solution), two or three times a day, is sufficient. The arsenic has at the same time a good influence on the general condition, as many patients, especially children, are anemic. Bromide and phenobarbital do not contraindicate the use of iron. A great difficulty arises from the rather common chronic constipation, which in my cases was always of a spastic nature. One should avoid giving saline cathartics, as they increase the elimination of bromide. I usually regulate the patient's diet and give aromatic fluidextract of cascara sagrada and occasionally castor oil; I seldom give belladonna.

The dietary treatment is the oldest mode of attack on epilepsy, but few facts are known. In many cases I adjust the diet according to the patient's complaints and the results of the gastric analysis. The average patient is advised to live according to a schedule which also avoids constipation. The diet which I advise in the average case is:

For breakfast, bran cereal, stewed or raw fruit, bread or toast, egg and milk with coffee. For lunch and dinner, one raw and one cooked green vegetable, bran, whole wheat or brown bread, stewed or raw fruit as dessert, with meat only once a day in the shape of white meat (no roast beef, ham, steak, pork, salt or shell fish) and no hot bread. Choice of fresh fish, chicken, mutton, lamb, fowl, vegetables, rice, spaghetti, macaroni, boiled potatoes, green salad. One or two glasses of water, mid-morning and mid-afternoon, and one half dozen prunes which have been soaked in water all day to be taken at night together with the water in which they were soaked.

I advise the patient to avoid alcohol entirely and to take little coffee and tea, no pepper, not much vinegar and nothing highly seasoned. The meals should not be eaten late at night, and the patient should be taught to eat slowly. No additional salt or salted butter is allowed. This procedure gives a more or less steady daily intake of chloride. The fluid intake ought not to be allowed to vary greatly from day to day so that one can prevent any disturbance of the chloride-bromide equilibrium.

It is important to pay attention, not only to the convulsions and petit mal attacks, but to the psychic equivalents in the form of mood disturbances, twilight states and fugues. Pierce Clark pointed out the features of the prepsychotic and psychotic personality. It is wise to keep in mind that idiopathic epilepsy embraces a heterogeneous group of cases. The aim ought to be to single out types which form groups with special indications. An epileptic person is one who reacts to many factors with his whole psychobiologic personality. The same attention has to be paid to the personality and to the symptoms. Disappearance of the attacks, therefore, does not necessarily mean cure or even improvement. The whole personality has to react favorably. Considering the attacks as well as the whole illness as an individual reaction, one always investigates the factors which might have caused any new attack. One must pay due attention both to somatic and to situational problems. Epilepsy is best formulated as a complicated reaction of a psychobiologic type in which one must control all the facts and factors which are found at work. The treatment of fundamental and decisive causes is still limited as one has not sufficient knowledge of the factors at work. Syphilis has always to be excluded; if it is found, the patient must be treated for it. In alcoholism, which may be the cause of epileptic convulsions, strict abstinence is the only solution. Few cases of epilepsy are caused by cranial injuries. Kocher's idea that a high intracranial pressure may be the cause led him to perform many operations, but he had few good results. Cases in which the fits seem to be caused by painful scars of the scalp or diseases of the teeth, ear, nose or eye, e. g., so-called reflex epilepsy, are no doubt rare. The surgeon may get results by removal of peripheral stimulation even in a patient with a genuine epileptic constitution.

METHODS OF TREATMENT

My associates at the clinic and I determine the sodium bromide content in the blood and the amount of replacement of the chlorides. After some time, a bromide-chloride equilibrium is established which has the desired therapeutic effect. Each patient reacts to a different degree of chloride replacement, and the same doses of bromides produce a different storage in each patient. A diet which is poor in salt is necessary in order to get sufficient storage with small doses of bromide. Change in the chloride intake immediately disturbs the equilibrium. We replaced Ulrich's

method of determination of bromide by the one of Walter with Hauptmann's modification. This method gives less accurate but sufficiently satisfactory results.[1]

After having examined a patient carefully and having determined or excluded causal factors, we begin with a small dosage of phenobarbital which gives a certain amount of control of the attacks. This will give the patient confidence. At the same time, we administer 7½ grains (0.05 Gm.) of sodium bromide three times a day, which we increase after two weeks to 10 grains (0.65 Gm.) three times a day. The small doses at the onset, with the gradual increase, are necessary in order to prevent a sudden accumulation leading to intoxication in susceptible patients. In patients with predominating night attacks, we use chloral hydrate, from 7½ to 10 grains, in the evening. The accompanying charts indicate the methods of observation. The upper curve represents the bromide storage in milligrams per hundred cubic centimeters of blood; the lower curve, the sodium chloride replacement (in percentage). The medication is presented through the dark fields (the bromide dosage is indicated in grams in the scale at the left and by the upper dark stripe; the phenobarbital dosage can be recognized by the lower dark stripe, representing doses from 0.03 to 0.2 Gm.). The cross hatchings in the lowest line indicate convulsions; the strokes indicate petit mal attacks and the dots, aura-like experiences, dizziness and sensations.

Charts are kept in all cases with the help of the patient and of the laboratory. They allow the necessary perspective and appear to be the only way of supervising the treatment according to the development of the case.

REPORT OF CASES

The first three cases presented are those of "demented" patients who were irregularly under treatment with phenobarbital. The patients all showed steady improvement under bromide, which was administered in different dosage in each case and was retained to a different degree.

CASE 1.—*History.*—A man, aged 30, who had had petit mal attacks since early childhood and grand mal attacks for fifteen years, in recent years had had several attacks of petit mal each week and convulsions once a month. He had shown a gradual change and had become slow in his behavior, accurate, pedantic and circumstantial, getting irritated easily when interfered with. He was dull, and it was hard to get along with him as he insisted that he knew everything well. His physical health was good.

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1. Two cubic centimeters of serum is measured into a 10 or 15 cc. test tube, and 4 cc. of distilled water and 1.2 cc. of trichloracetic acid are added. The tube is well shaken and allowed to stand for one-half hour. To 2 cc. of the filtrate is added 0.4 cc. of gold chloride. After being mixed thoroughly it is compared against the Buerke's colorimeter or a specially prepared solution. The sodium bromide content is determined with the formula:

$$\frac{20 \times \text{standard mg. NaBr}}{\text{reading of serum}} = \text{mg. NaBr per hundred cubic centimeters of serum}$$

The reagents needed are trichloracetic acid (20 per cent in distilled water) and Merck's acid brown gold chloride (0.5 per cent in distilled water). To be independent of the colorimeter, a stock solution which contains 143 mg. of sodium bromide to 100 cc. of water is prepared, and 1 cc. of trichloracetic acid and 1 cc. of gold chloride are added to 5 cc. of the standard stock dilution.

Course.—A month after treatment with bromide was started, the convulsions disappeared. The petit mal attacks became less frequent and at the time this paper was written had been absent for six months. They were first replaced by occasional auras (dizzy feelings) which were checked by a daily dosage of ½ grain of phenobarbital. Having omitted medicine for a few days, he reacted with one convulsion and several petit mal attacks which ceased with continued medication. The mental symptoms grew less marked, and he was able to get along better with people (with sodium bromide, 5 Gm., he maintained a level of 325 mg., or 33 per cent replacement).

CASE 2.—*History.*—A man, aged 39, had had convulsions since the age of 14, occurring first about once a month but in the two years before admission more frequently (once a week, there were three or four attacks at night, which left him dazed in the morning). He had to give up work because he became forgetful and much preoccupied, and was often confused as to where he was and what he

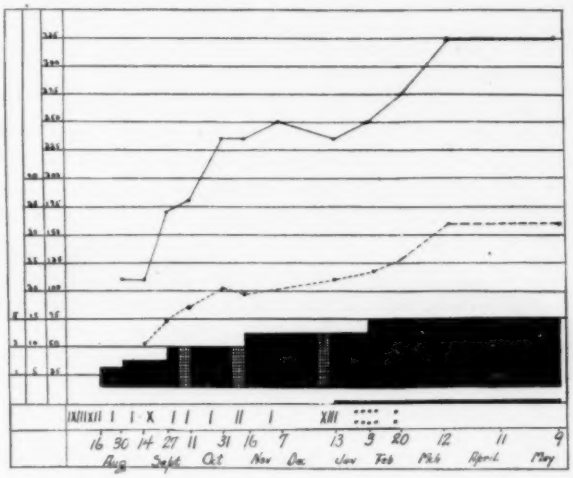

Chart 1 (case 1).—A man, aged 30, had had petit mal attacks since infancy and convulsions for fifteen years. Before treatment was started, the patient had daily petit mal attacks and one convulsion a month. Under treatment, the symptoms disappeared. In this and the following charts, *X* indicates convulsions; *I* petit mal attacks; dots, aura-like sensations; the solid line represents the bromide in milligrams in 100 cc. of blood; the broken lines, the presentation of replacement; the batched areas show the times when the patient took his medicine irregularly; the bromide dosage is indicated by the upper dark stripe; the phenobarbital dosage, by the lower dark stripe.

he had to do. He was in good physical health, but was slow and circumstantial, showed marked perseveration, had difficulties in grasping, was uninterested and seemed to have a poor memory for recent events. He complained about people not liking him and was irritable and suspicious. The patient was considered hopeless and commitment papers were made out.

Course.—The patient was given phenobarbital, ½ grain, three times a day and with increasing doses of bromide was free from convulsions the first three months. Then he had two convulsions after the phenobarbital had been stopped (too early, as the bromide was only on a level of 11 per cent replacement). Two more con-

vulsions occurred two months later, but after that he was free from attacks with the exception of one petit mal attack in September, 1927. In August, 1927, he began to work again as a laborer and has been working since, doing quite well and feeling at ease in dealing with people. He is less slow and dull. The confused episodes have been entirely absent for a whole year and memory has improved. With a daily dosage of 5 Gm. of sodium bromide, he maintains a level of 270 mg. or 26 per cent replacement.

Case 3.—*History.*—A man, aged 53, came to the dispensary in December, 1926, with a history of convulsions since August, 1926. He had had two more convulsions since and two convulsions and two petit mal attacks the day before he came. All these attacks occurred at night. The patient was in good physical health. He was slow in his behavior, circumstantial, dull, uninterested, and worried about his health. He was given phenobarbital, ½ grain, three times a day, but the attacks increased in frequency. He had a convulsion once in two weeks and petit mal attacks several times a week.

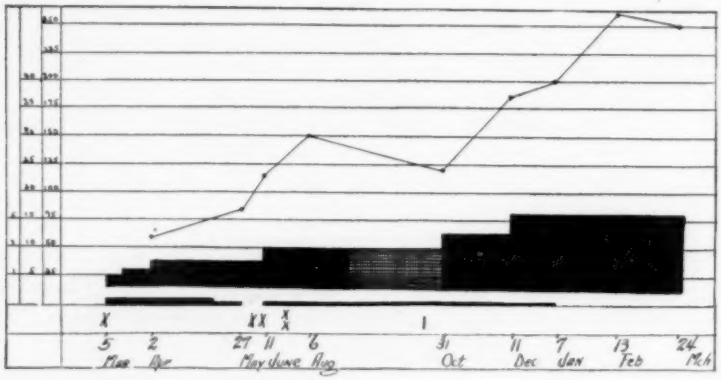

Chart 2 (case 2).—A patient, aged 39, had had convulsions since the age of 14. For two years he was unable to work and showed marked mental changes and frequent episodes of confusion. The convulsions disappeared under treatment; the man was able to support his family and showed marked mental improvement.

Course.—At the end of March, 1927, the patient was given combined phenobarbital and sodium bromide. The bromide was increased to 20 grains (1.3 Gm.) three times a day; the phenobarbital was gradually decreased from ½ grain three times a day and was stopped in August, 1927. The patient reacted well to the treatment, having only one convulsion. In August, 1927, the petit mal attacks became less frequent and they ceased in October. There were two aura-like sensations in November. He has felt well since, is more active and works hard as a laborer, supporting his family. This patient can be controlled by a rather low bromide content (26 per cent replacement) with 4 Gm. of sodium bromide.

Comment.—The charts in these three cases demonstrate well that individualizing medication is necessary and that an individual replacement, which is not necessarily parallel to the doses of bromide, controls the attacks. Irregularities in taking the medicine or in the diet (salt and fluids) change the bromide level, and its results can be observed in the clinical symptoms. The change from grand and petit

mal attacks to aura-like sensations is characteristic but can often be controlled by small doses of phenobarbital. This can be seen in case 4.

CASE 4.—*History.*—A youth, aged 19, developed twitchings of the left arm and head at the age of 11. Six months later he began to have convulsions which recurred once a month, usually at night. In recent years these attacks had increased, and when he came to the dispensary, in March, 1927, he had one convulsion at night every two weeks and one petit mal attack every day. He also complained of frequent peculiar sensations in the arm and head and of a "restless fear." This usually occurred several times a day. He was slow, circumstantial and dull. He had been treated with phenobarbital and bromide since 1923, but was never under rigorous treatment. A ketogenic diet was tried several years before I saw him.

Course.—The patient was given phenobarbital and bromide. The latter was increased to 20 grains three times a day. The phenobarbital was decreased, then withdrawn for three months, and then doses of ½ grain at 8 p. m. were given

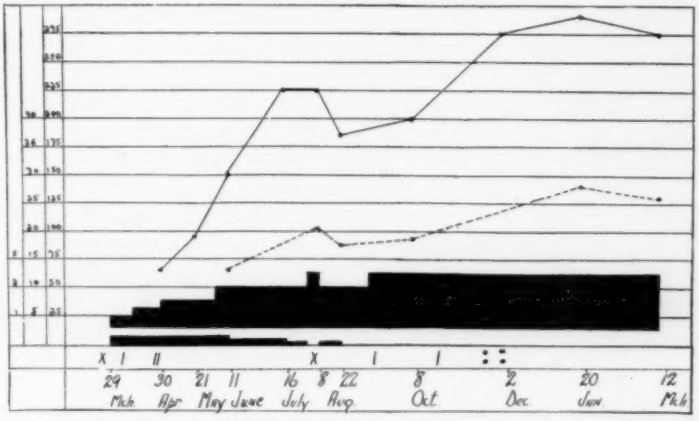

Chart 3 (case 3).—A man, aged 53, had had convulsions and petit mal attacks for four months; the condition was not controlled by the administration of phenobarbital. The symptoms disappeared under treatment.

again. The convulsions have ceased entirely since December, 1927. The petit mal attacks have not occurred for nearly a year. The peculiar sensations in the arm and head occur less frequently. He has them now once every two days.

It was found almost impossible to teach the following patient to take the medicine regularly.

CASE 5.—*History.*—At the age of 15, this boy began to have twitchings in both hands which lasted approximately ten minutes. They occurred about six times a day. Six months later (September, 1922), he began to have convulsions which recurred about once in two months. He was under bromide treatment (doses unknown) for several years. The twitchings in the hands ceased three years before I saw him. The patient was always in good physical health, but he became slow and circumstantial in his behavior and dull. Under treatment with phenobarbital the attacks stopped, but he often forgot to take the medicine, and

this caused a status epilepticus in November, 1926, and others in December, 1926, and in January, 1927.

Course.—He was given combined sodium bromide and phenobarbital in April, 1927, starting with phenobarbital, 1 grain four times a day, and bromide, 5 grains (0.3 Gm.) four times a day. The bromide was finally increased to 20 grains, three times a day. He did well, but had a series of convulsions on May 12 and on June 13. In October, he had a series of petit mal attacks. After that he was free from any attacks until February, 1928. In March, the amount of phenobarbital was reduced from 1 grain twice a day to ½ grain twice a day, and the patient reacted with one convulsion and several petit mal attacks. Phenobarbital and bromide were therefore continued. At the time this paper was written, the patient felt well and was less dull and slow, but on the whole there was little improvement. The danger of status epilepticus in this patient is diminished with bromide treatment, but it is questionable whether he will show much more improvement.

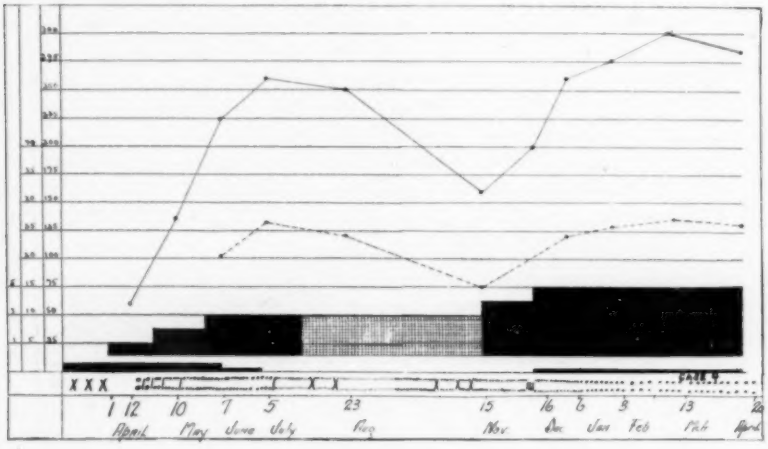

Chart 4 (case 4).—A youth, aged 19, had had convulsions, petit mal attacks and "sensations" in the arms and head since he was 11. Under treatment, the symptoms disappeared except for the "sensations" which were less frequent. The patient took medicine irregularly, as shown by the irregular bromide curve. The large dots indicate general sensation through the whole body; the small dots, momentary sensations in his arms.

Case 6.—*History.*—The dangers of irregularly taken phenobarbital are clearly demonstrated in a woman, aged 20, who, from the age of 1½ years up to 15 had frequent convulsions and epileptic equivalents of a peculiar kind. In the last five years she had had only convulsions. They were associated with the menstrual period (from four to five attacks occurring three or four days before a period, no attacks during the rest of the month). Since the birth of a child, a year before I saw her, she had been in poor physical health and had begun to have almost daily petit mal attacks. In February, 1927, she came to the dispensary where she received phenobarbital, ½ grain, three times a day. She was slow in her behavior, dull, uninterested, irritable and fussy. Two weeks later she forgot to take phenobarbital during three days and had a severe status epilepticus. We then gave the

patient combined phenobarbital and bromide treatment. The bromide was gradually increased to 15 grains (0.9 Gm.) three times a day. At the same time the amount of phenobarbital was decreased.

Course.—The patient did not take the medicine regularly during the first two months. Then, it was possible to reeducate her with the help of her family. At the same time an adjustment of her social situation was tried. The attacks ceased for six months with an exception in December when she had two petit mal attacks after excitement at the onset of a menstrual period. Her mental condition cleared up, she was more lively, took interest in her child and began to grasp questions more quickly. Her irritability was less marked, and the general health improved a great deal. She did not come to the clinic after January, 1928, because she was still getting along well.

COMMENT

The cases presented are characteristic of the material in the dispensary. In most of these patients the seizures are of long standing,

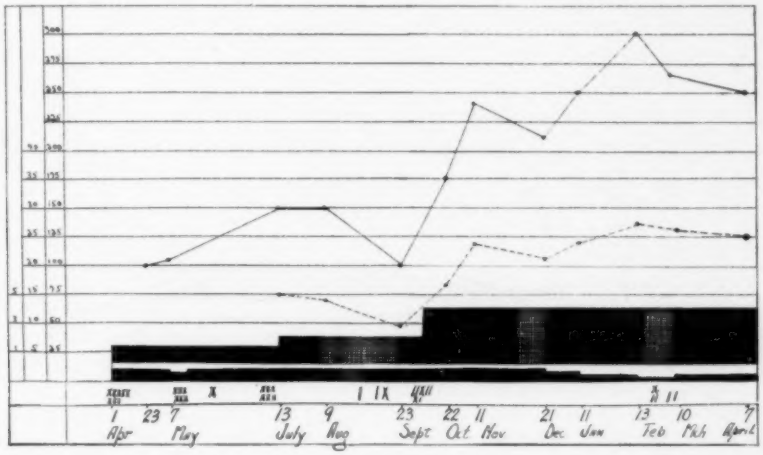

Chart 5 (case 5).—A youth, aged 19, had had petit mal attacks and convulsions since he was 15. There was an inclination to status epilepticus. Improvement occurred under treatment. The patient took the medicine irregularly and reacted to diminution in the amount of bromide given with a series of symptoms.

and deterioration is present. They are considered a burden by the physician and are usually treated as such. My case reports show that even in these cases much can be achieved. The patients in cases 1, 2 and 3 are supporting their families, and are able to do hard labor. They are not exceptions. With this method of treatment, the patients do not need to come to the clinic more than once in a month or six weeks. The result of the blood test can be determined on the same morning that the physician dismisses the patient. In a few minutes, he can orient himself concerning the patient's needs and give the necessary advice for possible adjustments. The questions which have to be asked during every consultation deal with the frequency and the nature of the

attacks, general health, reactions to surroundings, gastro-intestinal disorders, especially constipation and reaction to menstruation. Some patients have more attacks before or during the menstrual period. I have often succeeded in preventing this by a larger dosage of phenobarbital at this time. Constipation, which is a frequent handicap in persons with epilepsy, is aggravated by bromides, and therefore careful attention must be paid to it. Under prolonged treatment with bromide, some patients lose weight. This, together with the slight, irritative cough, may lead one to suspect incipient tuberculosis, especially as one knows that a high percentage of epileptic persons die of pulmonary tuberculosis. With the administration of salt and phenobarbital, these symptoms soon disappear.

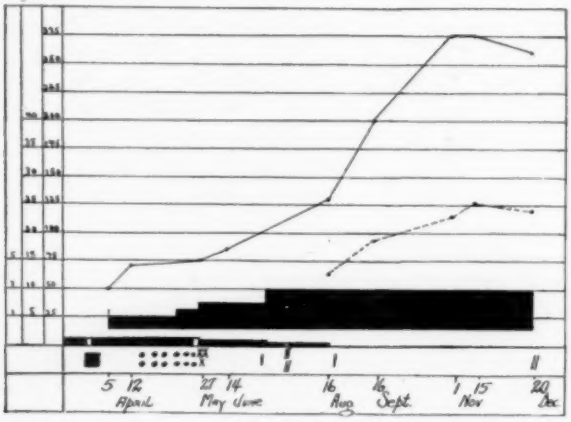

Chart 6 (case 6).—A girl, aged 20, had had convulsions since infancy which were controlled by phenobarbital, but the patient reacted with a status epilepticus when she forgot to take the medicine. General improvement occurred under treatment. The black square indicates serious status epilepticus.

It is important to make the patient understand his illness. This has to be based on an intelligible psychobiologic formulation in which one tries to point out the more conspicuous as well as the less conspicuous factors. General hygiene and diet will play an important rôle, and the patient must gain an idea of the treatment with bromide so that he can avoid lapses. All these patients are unreliable, and one therefore gives them written instructions in regard to diet and general hygiene. The necessity of frequent walks, fresh air, much sleep and good care of the teeth is pointed out. Advice is given against hot baths, but warm baths and showers are allowed. The patient must be warned against any hazardous exposure (swimming or driving a car). Excessive smoking is not advisable. The patient is requested to report at an appointed date and to bring a chart of his attacks.

Combined phenobarbital and bromide treatment, with a diet low in salt, gives a good bromidic effect with small doses (from 2 to 5 Gm. daily). In the average case, one needs a replacement of from 25 to 30 per cent of the chlorides in the blood.

The psychotherapeutic procedure depends on the individual patient. Questions readily bring out his attitude. His behavior during the consultation reveals the mental symptoms and changes. Analysis of special reactions and sex education and adjustment can be of great help. All patients are advised to keep up some healthy and favorable occupation which does not offer too many risks. Most children are able to return to school after a short time.

The adjustment of the situation at home is important. One must explain the patient's symptoms to relatives and ask for cooperation so that unnecessary friction may be avoided. In children one must warn against spoiling as well as against too strict a discipline. The relatives must help in having orders carried out correctly and in keeping the chart.

Some of my patients have been committed to state hospitals. These are persons who reacted with increased irritability and violent outbursts of temper to the suppression of the attacks. One must always keep in mind that such a patient is dangerous to himself and to his environment. One of my patients, aged 36, who had been suffering from epileptic convulsions and short confused states for six years, reacted unfavorably to phenobarbital and bromide, showing symptoms of intoxication after relatively small doses. During his frequent confused states, people often thought him drunk and mistreated him. It was necessary to commit him to an institution for his own protection.

Some patients cannot be influenced by phenobarbital, and effective treatment with bromide is impossible if their toxic zone is low. An intelligent man, aged 32, who developed petit mal attacks in the last four years has carried out orders strictly. Phenobarbital in large doses does not influence the attacks, which have become more frequent. Bromide has a toxic influence when a level of 170 mg. in 100 cc. of blood is reached (16 per cent chloride replacement). This amount is insufficient to stop the attacks. Another patient, who has epileptic convulsions on the basis of congenital syphilis, reacted well to bromide but developed severe ulcers, and it became necessary to administer phenobarbital. In this case, treatment with bromide was impossible because of the low toxic level. The same condition is apt to occur in persons with cerebral arteriosclerosis.

The most promising cases are those of patients who are seen in an early epileptic reaction without any or only slight mental symptoms. Unfortunately, these patients frequently do not sufficiently understand the seriousness of the illness. They stop treatment two or three months

after the attacks have ceased. These patients form a high percentage of the dispensary material. With recurrence of attacks they change physicians, but they will not adhere to any extensive treatment before the illness has progressed considerably.

SUMMARY

There are important advantages in treatment with a combination of phenobarbital and bromide. Phenobarbital controls the attacks, but does not have a specific influence on the epileptic process; its sudden cessation is dangerous. One must realize that most epileptic patients are not dependable and may fail to carry out orders carefully after they have improved. Sudden cessation of bromide intake is less dangerous. The bromide content drops gradually, and the patient will have one or two attacks under the decreased influence of bromide. These signs bring him back to the physician before it is too late.

Treatment is started with slowly increasing doses of bromide, phenobarbital being administered at the same time in an amount which more or less controls the attacks. After having established a sufficient storage of bromide in the body, one tries to keep a constant bromide-chloride equilibrium. This is obtained through determination of the bromide replacement of chloride, according to which one can alter the dosage. A diet low in salt (about 5 Gm. a day) increases the influence of bromide. Observing the effect of the bromide and noting improvement, one may decrease the phenobarbital gradually (1 grain each week) and eliminate it entirely or continue it only in small amounts. The amount of bromide should not be diminished before the patient has been free from attacks for one or two years, and the patients should stay under observation for several years.

Clinical and Occasional Notes

THE "PARETIC GOLD CURVE" IN DISSEMINATED SCLEROSIS *

HOWARD D. MCINTYRE, M.D., CINCINNATI

Lange considers — with much justification — that in spite of the fact that little is known of the nature of the colloidal gold reaction, it yields results of great clinical value and aids greatly in the differential diagnosis of certain diseases. The test was at first thought to be specific for paresis; later, Miller, Brush, Hammers and Felton confirmed Lange's work, but found that fluids from certain cases diagnosed as disseminated sclerosis gave curves of the paretic type. It can be stated that in spinal fluids which show a negative Wassermann reaction, with a slight increase of globulin, a negative cell count and a paretic type of precipitation of colloidal gold, in the absence of other signs of paresis in the central nervous system, it is well to consider the possibility of disseminated sclerosis. Greenfield and Carmichael [1] stated that "so far as we know, disseminated sclerosis is the only known condition, except encephalitis lethargica, in which the paretic curve may be obtained. Any curve of this type is, therefore, of great diagnostic value." In my personal experience, dealing with more than 100 cases of epidemic encephalitis, I have never observed a paretic type of gold curve. The only two conditions in which I have observed this curve are paresis and disseminated sclerosis.

The spinal fluid in multiple sclerosis has been investigated by many observers. The results obtained by the various workers agree fairly well. Ayer and Foster [2] reported the observations in thirty-eight cases in 1921. They did not find any increase in pressure above normal, a normal cell count in 61 per cent, and an increased cell count varying from six to forty-two cells in the remainder. The protein content was increased in about 50 per cent of the cases. The Wassermann reaction was always negative. The colloidal gold reaction showed a paretic type of curve in sixteen patients, and a tabetic type in seven patients. In other words, the paretic curve was obtained in nearly one half of the fluids examined and in nearly one half of the cases. Clarence Patton [3] stated that a review of hospital case records, with serologic studies and with typical clinical syndromes, shows agreement for the most part with the reports in the current literature; that the appearance and pressure of the spinal fluid is usually normal, though small increases of pressure are not infrequent, and that there is an occasional increase in globulin content; the colloidal gold curves range from negative, atypical and syphilitic to the paretic type. The paretic type of curve occurs in about one third of all cases. Ayer and Foster mentioned the variation in the type of curves

* Submitted for publication, June 21, 1928.

1. Greenfield and Carmichael: Cerebro-Spinal Fluid in Clinical Diagnosis, p. 169.

2. Ayer and Foster: Association for Research in Nervous and Mental Diseases—Multiple Sclerosis, New York, Paul B. Hoeber, 1921, vol. 2.

3. Patton, Clarence: Human Cerebro-Spinal Fluid: Systemic and Diffuse Degenerative Diseases Involving the Nervous System, p. 359.

in stationary and progressive cases, finding the paretic type of curve more common in the progressive cases.

The following cases illustrate the occurrence of the so-called paretic type of curve in multiple sclerosis. Such observations do not detract from the efficiency of the colloidal gold reaction as a diagnostic measure; it is one of the most efficient laboratory procedures available. In my experience with several hundred spinal fluids from known cases of paresis, the paretic type of curve was present in more than 95 per cent.

REPORT OF CASES

CASE 1.—*History.*—A white woman, aged 39, had been unable to walk or use her hands for eight years. The onset had been gradual.

Examination.—The fundus showed evidence of optic atrophy; there was bilateral ptosis and also a lateral nystagmus on looking to either side. The pupils were equal and reacted to light and in accommodation. The other cranial nerves showed no abnormality.

The biceps, triceps, radial, knee and achilles reflexes were hyperactive and equal on the two sides; the epigastric and abdominal reflexes were absent; there were bilateral Chaddock and Babinski signs; ankle and patellar clonus was present on both sides. The patient had a spastic paraplegia and was unable to walk. The urine and the blood count were normal.

The Wassermann reaction of the blood and spinal fluid was negative. The fluid contained three lymphocytes per cubic millimeter, with a slight excess of globulin. The colloidal curve was 5555431000.

CASE 2.—*History.*—K. W., a white woman, aged 28, was seen on Sept. 20, 1927. The onset of the illness had occurred about eighteen months before examination with numbness of the legs. In May, 1927, she became nervous and experienced dribbling of urine. The legs tingled greatly. About September 1, she had double vision, with some headache and vomiting at times. When seen the patient was confined to bed and could not walk.

Examination.—The fundi disclosed optic atrophy in both eyes. There was weakness of the internal rectus muscle of the right eye, and a slight nystagmus on looking to the right; there was also slight drooping of the right eyelid. There was slight weakness of the lower part of the face on both sides, and also a slight weakness of the soft palate with difficulty in swallowing. The tongue was protruded in the midline with a slight tremor. There was considerable speech defect of both the scanning and the slurring variety.

The biceps, triceps, radial, knee and achilles reflexes were markedly hyperactive — more on the right than on the left. The epigastric and abdominal reflexes were not obtained on either side. The Babinski, Oppenheim, Gordon and Chaddock signs were positive on both sides and were slightly more marked on the right. An inexhaustible ankle and patellar clonus was present on both sides.

The urine was normal. The Wassermann reaction of the blood was negative. The Wassermann reaction of the spinal fluid was negative; the cell count averaged seven and a half cells per cubic millimeter; there was a slight excess of globulin. The colloidal gold curve reading was 5555421000.

CASE 3.—*History.*—A. K., a white woman, aged 33, was seen on May 28, 1925, when she complained of numbness of the right arm. She had first noticed that she could not hold anything in her hand and would drop dishes and other household articles.

Examination.—The fundi were normal; the pupils were equal and reacted to light and in accommodation; there was a lateral nystagmus; no ptosis was present. The other cranial nerves functioned normally and there was no speech defect.

The biceps, triceps, radial, knee and achilles reflexes were markedly hyperactive — more on the right than on the left. The abdominal reflexes were not obtained. There was an inexhaustible ankle clonus on the right, but no clonus on the left; No patellar clonus was elicited. There were no plantar disturbances.

The Wassermann reaction of the blood was negative. The spinal fluid showed a negative Wassermann reaction and contained three lymphocytes per cubic millimeter; there was a slight trace of globulin. The gold curve was 555541000.

Course.—The patient has been observed since August, 1925, and has shown steady improvement. At present she has a slightly spastic gait and bilateral Babinski sign — more marked on the right — and an inexhaustible ankle clonus on the right.

CASE 4.—*History.*—W. Z., a white woman, aged 26, was seen on Sept. 14, 1925. Four months before she had had tingling first in the right and later in the left arm. Then she began to have a tingling sensation in both legs. She soon noticed weakness of the legs and became unable to walk without assistance. The weakness was more marked in the left leg. The tonsils had been removed and a search made for other foci of infection. No improvement followed removal of the tonsils. When she came to the office she could walk, but the gait was paretic and spastic.

Examination.—The papillae were normal. The pupils were equal and reacted promptly to light and in accommodation. There was slight lateral nystagmus. Neither ptosis nor exophthalmos was present. The other nerves functioned normally.

Reflexes: The biceps, triceps, radial, knee and achilles reflexes were hyperactive — more on the right than on the left. The abdominal reflexes were not obtained. There were bilateral Chaddock and Babinski signs, and also bilateral ankle and patellar clonus.

The blood count and urine were normal. The Wassermann reaction of the blood was negative. The Wassermann reaction of the spinal fluid was negative; there was a slight trace of globulin and four lymphocytes were found per cubic millimeter. The gold curve was 5555431000.

CASE 5.—*History.*—A white man, aged 35, was observed at the diagnostic center of the United States Veterans' Bureau at the Cincinnati General Hospital, his chief complaints being loss of control of the bladder and muscles of the legs, incontinence of urine, loss of sexual vigor, loss of memory and loss of the finer movements of the fingers and hands. He complained also of dimness of vision and double vision at times, a slight defect in swallowing and a speech defect. He had had influenza in 1918, while in the army, but was sick only four days. Recovery was apparently complete. In June, 1919, he first noticed a slight defect in maintaining equilibrium and that his memory was poor. He had worked as a brakeman on the railroad and had had to write down orders to be able to remember them. He had good insight into his condition. He began to have difficulty in speech soon afterward; the condition of the legs became worse, and he had to change his job from brakeman to baggageman. His difficulties gradually increased, until at the time of the examination he showed considerable defect in gait.

Examination.—The fundi were normal; the pupils were equal and reacted to light and in accommodation; there was a slight lateral and vertical nystagmus; the eye movements otherwise were negative. There was no exophthalmos, ptosis, strabismus or von Graefe sign. There was slight flattening of the right lower part of the face. The tongue was protruded in the midline with a fine tremor. The speech was of slurring type.

The biceps, triceps, radial, knee and achilles reflexes were hyperactive — more on the right than on the left. The epigastric, abdominal and cremasteric reflexes

were not obtained. There was a bilateral Chaddock and Babinski sign — more marked on the right side. There was an inexhaustible ankle and patellar clonus on the right side.

Coordination, Movement and Sensation: The Romberg sign was negative; the finger-to-nose test was well done with the exception of an intention tremor; the heel-to-knee test was well done with the left foot but was impossible with the right foot. The gait was spastic. There were no dissociated movements of the arms and legs in walking. There were no sensory disturbances.

A blood count showed nothing abnormal. Examination of the urine showed an almost constant trace of albumin, and at times fine granular casts. The blood pressure was 130 systolic and 70 diastolic. The Wassermann reaction of the blood was negative. Spinal puncture revealed a clear fluid; the Wassermann reaction was negative; there was a slight increase in globulin and eighteen small lymphocytes were present. The gold curve was 55552000. There was prompt response to jugular pressure.

SUMMARY

Five cases of multiple sclerosis are presented, showing the occurrence of a so-called paretic type of gold curve in this disease.

News and Comment

FIRST INTERNATIONAL CONGRESS ON MENTAL HYGIENE

The First International Congress on Mental Hygiene, of which Clifford W. Beers, founder and secretary of the National Committee for Mental Hygiene, has been elected secretary-general, will be held in Washington, D. C., May 5 to 10, 1930. It is being sponsored by a representative committee of mental hygiene experts, psychiatrists, educators and citizens from the following countries: Africa, Australia, Belgium, Brazil, Bulgaria, Canada, Denmark, Finland, France, Germany, Great Britain, Greece, Holland, Hungary, Italy, Japan, Luxemburg, New Zealand, Norway, Porto Rico, Russia, Spain, Sweden and Switzerland. The chairman of the committee on organization is Dr. Arthur H. Ruggles of Providence, R. I., president of the American Foundation for Mental Hygiene and chairman of the executive committee of the National Committee for Mental Hygiene. The vice-chairmen of the Committee are Dr. Samuel T. Orton of New York City, president of the American Psychiatric Association, and Dr. George E. McPherson of Belchertown, Mass., president of the American Association for the Study of the Feebleminded.

Among the American organizations which have been invited to membership in the Congress are the United States and Canadian National Committees for Mental Hygiene, the American Psychiatric Association, the American Association for the Study of the Feebleminded, the American Neurological Association, the American Psychological Association, the American Orthopsychiatric Association, the American Association of Psychiatric Social Workers and all state mental hygiene societies in the United States.

The program for the congress will be in charge of a committee headed by Dr. Frankwood E. Williams, medical director of the (United States) National Committee for Mental Hygiene. John R. Shillady, an expert in social work organization, has been appointed administrative secretary and general executive in charge of the affairs of the congress.

Abstracts from Current Literature

CLINICAL STUDIES ON THE QUESTION OF THE VALIDITY OF THE BELL-MAGENDIE LAW. R. WARTENBERG, Ztschr. f. d. ges. Neurol. u. Psychiat. **113**:518 (March) 1928.

In 1809, Walker, on purely theoretical grounds, declared that the anterior roots of the spinal cord are sensory and that the posterior are motor. About the same time, Lamarck expressed the same idea. In 1811, Bell showed that mechanical stimulation of the anterior roots caused movement, while this was not the case with the posterior roots. In 1822, Magendie showed that transection of the posterior roots in an animal caused anesthesia of the extremities concerned, but motion remained; on the other hand, transection of the anterior roots destroyed motility without influencing sensation. These experiments formed the basis for the Bell-Magendie law that the paths of the sensory and motor impulses are separated. In the spinal cord, the pathway of the former is the posterior roots, and that of the latter the anterior roots. Johannes Müller in experiments on frogs gave the best physiologic proof of this principle. On one side he cut the three anterior roots, and on the other the three posterior roots of the hind legs. The frog could not move at all the one leg in which he felt every sensation, while from the other leg, which preserved its motility, the foot could be cut off without the animal expressing pain by a defense movement. Further experiments supported the Bell-Magendie law and tended to show that all the anterior roots are centrifugal, and all the posterior roots centripetal. Thus it was shown that not only motor nerves, but also other afferent nerves pass through the anterior roots: vasoconstrictors, pupillary dilators, sweat nerves and pilomotor nerves.

In the course of time the Bell-Magendie law was subjected to further limitations. Stricker, for example, determined that electrical or mechanical stimulation of the posterior roots caused a local rise in temperature, due to stimulation of the vasodilators. Bayliss caused vasodilatation by stimulation of the cervical, dorsal, lumbar and sacral roots, and others showed also that the vasodilator fibers in the spinal cord of the dog run in the posterior roots. Steinach's work also disproved the purely centripetal nature of the fibers in the posterior roots. By stimulation of the peripheral stump of posterior roots he caused motor effects in the bowels of the frog, and Smith was able to prove there were motor fibers to skeletal muscles in the posterior roots. Further experiments have supported Stricker's view that the vasodilator fibers in the dog leave the spinal cord in the posterior roots. Recent work of Langley on cats supports this view. In man, Müller assumes that the vasodilator and sweat inhibitory fibers for the trunk and extremities leave the cord, not through the anterior, but through the posterior roots. Foerster proved this was so by stimulating the distal stump of a posterior root with an electric current, and observing a marked erythema shortly afterward. It is apparent, therefore, that the posterior roots carry more than purely afferent fibers.

The anterior roots, in addition to the motor fibers, contain vasodilators, vasoconstrictors, sweat fibers, dilators and accomodator fibers of the pupils. The evidence, both anatomic and physiologic, is not so clearcut as in the case of the posterior fibers, and is contradictory. Some authors believe that sensory fibers run in the anterior roots, while Purves Stewart says that the sensory impulses are conveyed only in the posterior roots. In opposition to this, Kidd concludes that there are afferent fibers in the anterior roots in man and also in other vertebrates. Frazier agrees with this. In 1920, Foerster made a report which demonstrated that pain fibers are present in the anterior roots. He says that "the anterior roots contain chiefly motor fibers, but also sensory fibers. Electrical stimulation of the central stump of a transected anterior root in man causes pain." To Foerster, the anterior roots form an auxiliary sensory tract which can be

pressed into service to greater or lesser degree on injury to the chief tract. Lehmann denies the Bell-Magendie law almost in toto, for he believes that the afferent fibers of the abdominal viscera are carried through the anterior and not through the posterior roots. This view has been very much contested, however, and Foerster believes that it is not correct.

The entire question of the Bell-Magendie law is therefore in a state of uncertainty. It can be investigated from the clinical point of view because many operations are and have been performed in transecting the posterior roots for tabetic crises, neuralgias and relief from spasms. If all the sensory fibers run in the posterior roots, cutting these should destroy sensation completely, whereas if some sensation is carried through the anterior roots this will not occur. Wartenberg has investigated this problem carefully since 1921, and has made systematic examinations to determine these points; some of the examinations covered a period of years and were frequently repeated. The simplest clinical methods of examination were used. Wartenberg evaluates the results of transection of the posterior root for tabetic crises and neuralgias in reported cases and in his own experience. Foerster and Kuttner report a case of gastric crisis in which resection of the sixth to the tenth dorsal roots was done; the patient remained free from pain for one and one-half years. In a case reported by Becker, the crises disappeared immediately after the operation. In a case reported by Rowntree, no crises occurred for three years after the operation. Many others have reported instances in which the posterior roots were severed in tabetic crises, following which there was no return of pain. On the other hand, in many instances the operation was not successful and was followed by a recurrence of pain. In some cases it was not of any benefit. Foerster reported cure in 49 per cent of his patients. In 1918, Frazier collected statistics on seventy-three patients operated on. Of these, 19.8 per cent were cured, 42.46 per cent relieved, 8.22 per cent temporarily relieved, and 6.85 per cent were not benefited. Critchley and Wolfsohn, in the most recent report, saw benefit in only one of four of their cases. Wartenberg reports two personal cases. In one of these, the fifth to the tenth dorsal posterior roots were cut on both sides with relief to the patient for a half year, followed by slight pains for a half year, and then extremely severe crises which were so bad that narcotics were not of any value and the patient was near suicide. This was true, says Wartenberg, despite the fact that six posterior roots were cut on both sides with resultant complete anesthesia of the skin of the trunk. In his other case, pains and crises also recurred four weeks after the operation.

Similar uncertain results have followed the cutting of the posterior roots for neuralgias. Several men have reported good results following these operations. Bennett first performed it and relieved a syphilitic neuralgia by cutting the first to the fifth lumbar and the first and second sacral roots. Jones relieved pain in the shoulder and arm by cutting the fourth to the eighth cervical, and Prince relieved pain in the hand and forearm by severing the fifth to the seventh cervical roots. Head reported a case in which an operation was performed by Horsley; the fifth to the eighth cervical and the first and second dorsal roots were cut, and severe pains in the arm were cured. Frazier relieved pain in inoperable carcinoma by resection of the seventh and eighth dorsal, and also a case of brachial neuralgia by resection of the fifth, sixth and seventh cervical and the first and second dorsal roots. Wartenberg reports several other cases in which pain of long standing was cured by cutting the posterior roots, and adds a case of his own in which relief, of six years' duration, was obtained. On the other hand, in many cases of neuralgia, cutting the posterior roots has been of no value. Sicard did not obtain relief in a case even after cutting five roots. Elsberg and Beer also did not influence the pain by cutting the seventh and eighth cervical and the first dorsal. Lehmann reported no relief from pain in the leg after cutting lumbar and sacral roots. In a case of Kaufmann, section of the ninth dorsal to the first lumbar left the abdominal pains as before. Foerster also reports no success in one of his cases. In 1912, he collected forty-four cases and found a lasting improvement of the pain in only twelve cases. Jacoby, in thirteen cases,

reported relief in only five. Groves, in twenty-four cases, found complete cure in six cases, relief in six cases, and no result whatever in three. Frazier collected the reports of fifty cases from the literature and found cure in seven cases, improvement in seven cases, partial relief in five, and ten were not affected by the operation. The results of cutting the posterior roots for relief from pain are therefore contradictory.

There are a few cases in which both the posterior and anterior roots have been cut or have been severed by trauma; in these cases also the evidence is contradictory. In Thornburn's case the fourth to the eighth dorsal were cut and also some anterior roots; this was followed by relief for seven years. In a case reported by Abbe of neuralgia of the forearm, the anterior roots, the sixth, seventh and eighth cervical and first dorsal and posterior roots, the fifth cervical and first dorsal were cut with marked improvement. In the case of Frazier and Skillern the sixth, seventh and eighth cervical roots (anterior and posterior) were evulsed, and at operation the fifth cervical and the first dorsal were cut. Pains in the arm, which were unbearable before, were relieved, but still persisted after the operation. In a case of Critchley and Wolfsohn of tabetic crises, the anterior and posterior roots from the seventh to the eleventh dorsal were cut with little relief to the patient. In another case of theirs of gastric crisis, posterior roots fifth to eighth dorsal, were cut bilaterally, and in addition anterior roots, fifth and seventh dorsal on the left and fifth, sixth and seventh dorsal on the right were cut. The gastric crises were unaffected by this extensive operation. Wartenberg reports a case of his own in which cutting all the posterior and anterior roots to a limb did not succeed in relieving the pain in the extremity. It is therefore apparent from this brief abstract that conflicting points of view exist concerning relief from pain by the severance of both anterior and posterior roots. Wartenberg points out that there may be certain errors in some of these cases, not the least of which is that not enough roots were cut. Also, in the case of pain one is unable to say where the primary irritating stimulus lies, and hence cannot determine the exact site for operation.

Wartenberg says that some observations point to the existence of meningeal and intramedullary pain. After an operation for resection of the posterior roots, meningeal pain may later arise through the fact that the meninges are injured directly or by adhesions from postoperative trauma. A few such cases have been recorded. Short has reported severe changes in the cord following severance of posterior roots. Hassin has found small areas of softening in the cord after trauma. In other instances also, changes have been found within the cord in cases in which severe pain was clinically present. The pains are intramedullary in syringomyelia, syringobulbia, intramedullary tumors, multiple sclerosis, intraspinal hemorrhages, etc. Foerster has observed severe contralateral pains on electrical stimulation of the anterolateral tracts. Hauser and Weisenburg and Stack assume that in the medulla and pons pains are primarily released and can be appreciated peripherally. Gordon Holmes, on the basis of war experience, is in favor of the existence of intraspinal pain. Just as in cord trauma the origin of the pain is intramedullary, so also is the case probably in herpes zoster. This disease involves not only the posterior roots and ganglia, but also the posterior horns, and Wohlwill has recently shown that the spinal cord is diseased with great regularity in cases of herpes zoster. It is probably for this reason that the cutting of the posterior roots is of no value in relieving the pain in herpes zoster. Against the view that persisting pains after section of the posterior root are intraspinal in origin, can be brought forth the view that after cutting the roots the fibers conducting sensation are degenerated and can therefore neither conduct nor cause pain. Wartenberg says that little is known, however, about the intraspinal mechanism of pain conduction. Wartenberg mentions also the possibility that persisting pains after cutting the posterior roots may be purely psychologic. He points out how complicated is the entire question, and how careful one must be in evaluation.

Wartenberg is concerned finally with the sensory conditions that are produced by cutting the posterior roots. Angerer, after bilateral section of four roots, found

no sensory defects. Bengart, in resecting a similar number of roots, found only a hypesthesia for all modalities. Clark and Taylor, and Hildebrand after section of four or five posterior roots did not find any sensory defects. Richter found sensation intact after the resection of the fifth, sixth and eighth cervical and first dorsal roots. Foerster, on resection of four or five roots, found that the sensory changes were slight. He reports other cases also in which cutting posterior roots did not produce any sensory changes. In a certain number of cases there have been sensory changes after operation, but these receded more or less. In contrast to these cases, however, there are many reported instances in the literature in which cutting the posterior roots has led to marked sensory changes. Bruns found anesthesia and analgesia after resection of three dorsal roots. Foerster, after resection of four dorsal roots, found a zone on the trunk which was anesthetic to touch, pain, heat, cold and pressure. Gulecke found an analgesic zone on the trunk after resection of the seventh to ninth dorsal roots. Groves, after resection of six posterior roots, found a complete anesthesia for all sensory modalities. Ballance cut a single root and noted a persistent sensory disturbance in temperature. Head in two cases of resection of posterior roots found sensory disturbances of a dissociated character in a small zone. Sicard in one case in which he cut five roots found only a small anesthetic area on the outer surface of the arm, and in a second case in which he cut seven roots, found a complete anesthesia of the entire arm. Lehmann cut the last five posterior cervical roots and found in a part of the arm that touch, temperature and pain were increased, while pressure was lost. In a second case he resected the fifth cervical to first dorsal roots and found pain, touch and temperature lost, and pressure present. Frazier has stated that in cutting the posterior roots, the thing that has impressed him most is the variability of the sensory conditions following thereon. In many cases there is complete anesthesia; in many the anesthesia is transitory, in others persistent, and in still others there is a hyperesthesia. The whole situation gives rise to the question whether the anterior roots do not play a rôle in the conduction of afferent impulses.

Wartenberg reports several instances from his own experience of section of the posterior roots. In case 1 he cut the second, third and fifth lumbar and the second sacral roots bilaterally and produced complete loss of sensation to touch, pain and temperature. Slight pressure was preserved. Deep pressure and pain sensations also were preserved in the presence of superficial loss of these sensations. In case 2 six dorsal roots were cut, with resulting anesthesia for touch, pain, temperature and light pressure. Deep pressure was preserved. In a similar case, there was anesthesia of the skin, while pressure, both superficial and deep, was preserved. In two other cases, after cutting the posterior roots on one side, there was loss of superficial sensation, just as in the aforementioned cases, but in the latter pressure pain was lost. The only sensation which remained intact was deep pressure. If the results of cutting the posterior roots are compared to section of the gasserian ganglion they are found to have a good deal in common. Spiller found that after destruction of the gasserian ganglion by tumor, deep sensation remained intact, while all other forms of sensation were lost. Ivy and Johnson reported similar conditions in two cases. Maloney and Kennedy found that after resection of the ganglion, deep pressure pain remained on the face. These, and many other reports by Frazier, Sachs, Hartmann, Davies and others demonstrate that after section of the sensory root of the gasserian ganglion, there is loss of all types of sensation, but pressure pain is preserved. Wartenberg adds nine cases of his own which support this observation. Comparison of these cases with those of section of the posterior root shows also that in the latter superficial forms of sensation are lost, but deep pressure and pressure pain are preserved. It is important to note that in the cases of resection of the posterior roots the area of sensory change was smaller than would be expected from the number of roots cut.

Both anterior and posterior roots have been cut in man in some instances. In these cases there is a loss not only of superficial sensation, but also of pressure

pain. Such cases have been reported by Spiller, Frazier and Skillern, Shawe and others. Wartenberg reports six cases from his own material in which both anterior and posterior roots were cut. These do not agree with the reported cases, because in most of his instances deep pressure and pressure pain were preserved after cutting both anterior and posterior roots. Wartenberg attributes the difference in results in all these cases of section of the posterior root to the intervention of the human equation in the sensory examinations. This explains many discrepancies in the observations. Moreover, in many cases of resection of the posterior root the operation of resection was not complete, and this explains differences in observation. The overlap principle of Sherrington explains some of the observations. In Wartenberg's cases certain characteristics of the sensation following resection of the posterior root stand out. One is that superficial sensation is lost; another is that the deep pressure and pressure pain are retained. Wartenberg points out, however, that only a small quota of the normal deep pressure sensation remains after resection of the posterior root. All of it is not retained by any means. This deep sensation comes from the deeper tissues, and the exciting stimulus is deep pressure. It is not due to overlap by neighboring nerves. Some of it may be carried through the sympathetic system. Wartenberg states that the facial and accessory nerves may be afferent and that these carry deep pressure sensations.

ALPERS, Philadelphia.

FAMILIAL DIFFUSE SCLEROSIS (LEUKODYSTROPHIA CEREBRI PROGRESSIVA HEREDITARIA). MAX BIELSCHOWSKY and RICHARD HENNEBERG, J. f. Psychol. u. Neurol. **36**:131, 1928.

Diffuse cerebral sclerosis is a concept which has wrongly been made to include various heterogeneous diseases. Excluding some of the cases of blastoma, which have also been incorrectly included among the diffuse scleroses, there are really only two types of cases which can justifiably be designated as cases of diffuse cerebral sclerosis: (1) the exogenous, inflammatory and (2) the endogenous, degenerative types. In the former there is, in addition to the exudative manifestations of the vessels, a confluence of smaller perivascular foci into larger focal lesions; in the latter, there is a symmetrical breaking down of the myelin in the cerebral hemispheres which is replaced by a gliogenous mass that is extremely rich in fibers. It has also been attempted to express the histogenetic contrast between these two types nomenclaturally. Thus, Schilder designates the inflammatory cases as encephalitis periaxialis, and Spielmeyer speaks of a sclerosing inflammation of the white substance of the cerebral hemispheres. Special terminology has not as yet been successfully applied to the endogenous degenerative types. Here and there a case is encountered which cannot be classified pathologically. This is due to the fact that occasionally in the exogenous cases the exudative vascular component of the lesion is unusually slight, and similarly in the degenerative cases the adventitial lymphatic apparatus may be so flooded with broken down products that the white cells and plasma cells appearing during the resorptive process are so numerous that the observer can readily be misled as to the true nature of the pathologic process.

With present methods, pathologic anatomy offers little assistance for the nosologic characterization of the pathologic observations. To obviate some of these difficulties the problem has been approached by various authors from the genetic point of view. The fact that endogenous degenerative forms of diffuse sclerosis occur in a number of cases as a familial disease has been adduced as evidence that hereditary factors were of some definite significance as regards the pathologic changes, so that the condition began to be regarded as a special form of heredodegeneration. Thanks to the early and intensive investigation of this problem by Krabbe and Scholtz, one is now in a position to distinguish the infantile cases, running an acute clinical course, from the juvenile cases, with a more subacute course. These same studies have also widened the conception of the disease described by Merzbach and Pelizäus—a disease the classification of which had

hitherto been extremely difficult, but which is now also regarded as a chronic form of the same heredodegenerative type of disease. On the histologic observations alone it is manifestly impossible in most of the so-called sporadic cases to establish the heredodegenerative basis, because it is difficult to determine the familial and hereditary relationship between the members of a given family tree affected with nervous disease. But even these cases frequently assume a heredogenerative characteristic when one takes into consideration the clinical and anatomic conditions presented by the cases that have been demonstrated positively as hereditary. The object of this contribution is to report a sporadic case which has been well studied clinically, anatomically and genetically, and which assumes microscopically an intermediary position between Scholz's juvenile and the Merzbach-Pelizäus chronic forms; it is also noteworthy that in this case there is also a reasonable probability for a hereditary basis.

Clinically, the cases described by the authors showed practically the same characteristics as those described by Scholz: The patients were well developed physically and mentally until the onset of the illness which began with deafness, blindness, imbecility and spastic paresis of the extremities. From a hereditary point of view, the following could be elicited: The mother had given birth to four children; the first and third were afflicted with the disease and are the subjects of this article; the second child, a boy, died at the age of 1 year in status epilepticus, which came on suddenly and without recognizable cause. It is conceivable that this child may also have been afflicted with the disease, especially since the mother said that the boy had just begun to learn to walk when he began to have convulsions; after that he seemed to have forgotten how to execute this function. Whether another infant (fourth pregnancy) that had died immediately before birth was also affected with a familial disease is difficult to state. One of the maternal brothers has two healthy children, while another one died of convulsions at the age of 9 years. The maternal father had a peculiar gait (his knees were held in adduction while walking), and the maternal grandmother suffered from repeated apoplectic strokes which made their first appearance at the age of 40. These hereditary factors, although they need further investigation, are sufficiently important to show that in this family one is dealing with a "recessive motor heredity" and that the disease under discussion was transmitted through a healthy mother to her male offspring — a metaphectic type of heredity. In contrast to the older generation of patients in this family, the disease in this branch of the tree began during the second dentition.

The cases also resemble physiopathologically those reported by Scholtz. In the terminal stage of the disease, the former also presented evidences of decerebrate rigidity. In this stage of the disease, the entire symptomatology was closely allied to that usually found in amaurotic family idiocy, especially its juvenile form. In the anatomic differential diagnosis only two diseases need be taken into consideration: (1) the exogenous form of chronic encephalitis leading to diffuse sclerosis, and (2) multiple sclerosis. A study, however, of the relationship of the lesions to the connective tissue apparatus of the blood vessels in the former and the lack of symmetrical involvement as well as the absence of remissions are sufficient to distinguish it from the latter.

The basic disturbances in familial cerebral sclerosis are to be found in the tissue components of the central nervous system the function of which is to convey nutrition to the nerve fibers and to maintain their metabolic equilibrium. The peculiar localization of the pathologic process with the most intense demyelinization in the posterior portions of the cerebral hemispheres is not easy to explain. Bielschowsky and Henneberg cannot subscribe to Scholtz's theory, which maintains that the localization is due to a peculiar type of vascularization in this region. They are more inclined to believe that the coarse localization of the diseased areas is fixed genotypically. In substantiation of their theory, they call attention to the fact that in sporadic cases there occur families in which the disease shows most marked myelin changes in the frontal lobes.

Although knowledge of the microscopic changes in Merzbach-Palizäus' disease is as yet incomplete, nevertheless, one cannot fail to see that there exists some

close relationship between the pathologic changes of the latter and those of the juvenile forms of diffuse sclerosis. A study of these changes side by side would seem to indicate a similar pathogenesis for both these diseases. In the Merzbach-Pelizäus cases, the cause of the pathologic changes, which affect predominatingly the conducting elements of the white matter, must also be sought in profound disturbances of nerve metabolism.

In proof of this contention, the authors describe clinically and anatomically a case which stands in an intermediate position between Merzbacher-Palizäus' disease and the juvenile form of familial diffuse sclerosis. This case also occurred in a boy who, at the age of 6 years, developed shaking movements of the head, nystagmus, contractures of the lower extremities, a peculiar speech disturbance, intention tremor of the limbs and interference with voluntary movements. The relatively slight involvement of the psychic functions was in striking contrast with the severe pathologic changes observed in the myelin sheath preparation. There could not be any doubt that here one was dealing with a progressive disease during which extensive areas of white matter had undergone severe destruction. In considering the pathogenesis in this case, one is also struck by the fact that he is dealing not only with banal pathologic changes (a breaking down) of the glia and of the adventitia of the blood vessels, but also with an intense accumulation of prelipoid substances in the fixed cells of the vessel wall — a condition also encountered in the juvenile forms of diffuse sclerosis and regarded by the authors as an expression of insufficient production and transportation of nutritive material. Although the authors have no definite knowledge concerning the hereditary and familial factors in this case, they think that here too one is dealing with a heredo-degeneration representing a type of nervous disease due to endogenous metabolic disturbances.

In addition to the cases of Merzbacher-Pelizäus' disease, there also exist other diseases in which the pathologic process is manifested by an unsystematized progressive symmetrical breaking down of the myelin. These are the cases described by Ostertag in which, in addition to the changes in the striatum and cortex, there was also found an extensive "myelolysis" in the white substance of both hemispheres. There may also be some microscopic relationship between these cases and certain cases of status dysmyelinatus (C. and O. Vogt) in which the demyelinization is most marked in the pallidum. In this connection, however, Bielschowsky and Henneberg want it distinctly understood that knowledge is as yet insufficient to warrant the inclusion of these and similar transitional anatomoclinical forms in this system of the diffuse scleroses.

In conclusion, the authors point out that the term "diffuse cerebral sclerosis" is unsatisfactory because it merely designates a terminal pathologic condition in a variety of different clinical pictures. Neither are they satisfied with the designation "myelosis," or "myelolysis," of the brain, because this does not emphasize sufficiently the nature of the pathologic process, and, furthermore, the term "myelosis" has been employed to designate columnar or funicular myelitis. These spinal myeloses have an entirely different etiology, most of them being secondary to severe cachexias. They would prefer to employ a term which would carry with it a suggestion of a metabolic disturbance in the white matter and also convey the idea of a hereditary basis and progressive character of the pathologic process. They would, therefore, employ the term "leukopathia" and what would be still more descriptive "leukodystrophia cerebri hereditaria progressiva." As subdivisions of this entity they would distinguish: (1) an acute infantile type (typus Krabbe); (2) a subacute juvenile type (typus Scholz), and (3) a chronic type (typus Pelizäus-Merzbacher).

KESCHNER, New York.

THE EPILEPTIC PSYCHE. L. PIERCE CLARK, State Hosp. Quart. **11**:669 (Aug.) 1926.

While a special psychopathology of epilepsy has been well described even as far back as Hippocrates, the modern tendency has been to study the epileptic seizure meticulously, while the individual peculiar traits have been overlooked. The

error in ascribing special features such as epileptic deterioration and dementia as similar to the psychic disintegration which follows other terminal mental disorders has been common. Only a few have been able to detect the mental characteristics of the potential epileptic person which presage the alteration in character and which are present at the onset of the first seizure or long before.

The epileptic states in order of their appearance are: (1) the epileptic constitution; (2) the epileptic alteration at the advent of a positive diagnosis of epilepsy; (3) the mental stigma of the confirmed epileptic person; (4) the epileptic deterioration or dementia in the terminal stages of the disorder. Two of these stages, alteration and mental stigma, are ill differentiated. Generally the alteration insensibly passes into the permanent stigma, and the transition has no specific line of demarcation. The alteration may be specifically an outgrowth of the primary defect of endowment, so that there may be really but one state in the morbid psychopathology—deterioration based on a defective make-up.

There are two fairly definite reasons for the occurrence of epileptic alteration: (1) the enforced projection of a person with unstable and inelastic behavior pattern into a continually widening social environment which requires an increased flexibility of adaptation, and (2), which is a part of the first, the reflex effect of hampering social customs on the personal egoistic demands of the epileptic patient. In the absence of any intellectual deficit the alteration is considered in the light of changes in character and behavior. Many investigators report only slight personality shrinkage and an entire intellectual intactness through a life-long epileptic career.

Alterations in character are generally present before the attacks, and many cases are cited wherein alteration and even deterioration are fairly advanced before the occurrence of the first fit. Before the seizure career is well begun the epileptic person is well known to possess little power of insight into his innate faults of personality. The epileptic personality is egocentric largely to protect reflexly the personality as a matter of instinct; the epileptic person has so integrated his entire personality about the nucleus of his narcissistic characteristics that the early defects are only partially recognized when pointed out.

Aside from being a compensatory motive, religion, pedantry, nicety of manners and speech may be due to a narrowing of the field. These reactions are tendencies to revert to the goal of the first departure in which infantile anal eroticism is the dominant characteristic. With the advent of alterations in character is a renewed tendency to fix on rigid patterns of conduct and behavior, and hand in hand with this is an impulsive and violence only vaguely noted before. These often correspond with the deeper and natural traits that may early break through the imperfectly acquired power of repression.

Undoubtedly sound fundamental laws cause these persons to react as they do; while some traits are merely reactionary, the major portion is motivated from within, and the individual is moving toward his destined goal, the result of vital mental laws, which some day will be clearly understood. With little power to resolve their conflict of inferiority many epileptic persons attempt to enter fields wherein they are greatly handicapped. At the outset of his seizures it is rare for the patient to seek a level of life adaptation that is best suited to his innate powers, which entails more rapid and irrevocable failure. Poor behavior reactions are further increased by frequent occurrence of attacks associated with concomitant amnesia, which render the small amount of power for flexible adaptation to break down still further.

If the initial changes in the character or behavior reactions of the epileptic person are chiefly those of disturbed social relations and efforts at adaptation, the second phase of the alteration may be characterized usually as a neurasthenoid type of reaction. These symptoms of exhaustion and fatigue, at first thought to be prostration induced by seizures, are at present believed to be a reaction of the whole organism to its enforced adaptations. This subjective feeling of inadequacy leads to a pronounced form of hypochondria. It shows itself in a slight clouding of the whole sensorium. There may be present a lowered rate of adaptive reac-

tions, and it is a signal that deterioration has begun. The physical and mental prostration deepens to an actual apathy and inability to concentrate. There may be palpitations of the heart, head and skeletal structures, cold sweats and ringing in the ears, evidences of an increased self-awareness at the expense of objectivated interests. The neurasthenoid state does not fully compensate the epileptic organism. The field of self-concern widens and deepens, the regression goes deeper and loosens the crude nonadaptive social instincts, with an ultimate sense of outrage and bitterness toward his environment. The epileptic patient's acts differ from those of normal controls during fits of anger. There is an evident cool and calculating manner in which the epileptic person commits his acts, showing that they emanate from a deep-rooted satisfaction of the coolest type of instincts; his antisocial acts are doubly motivated, hence their brutal excess.

Perturbations of the emotional mood are hardly secondary to the motor behavior of the epileptic person. The mental depression is less than in retarded depression and rarely reaches the suicidal level. The physical prostration outweighs the mental symptoms, and in this physical prostration one sees ill repressed states of moroseness changing to states of suspicion and distrust. The latter, while paranoid, are found to be differently motivated.

A cessation of spontaneous interest accompanies the physical prostrations, and the subject may state that orderly thought and activity are impossible. Anxious states and forebodings are present; the depressed state may be so marked that the epileptic person drops his customary employment; he is then on his way to deeper alteration — the stigma of the confirmed epileptic patient. He is adjusting himself as best he can to an intensive call for a keenly introspective life shortly succeeded by an endless procession of somatopsychic perceptions. For years all changes in character noted here were attributed to the use of sedatives, and early deterioration was caused by their continued use.

The states of excitement in the epileptic person, independent of epileptic mania, are less intense and shorter lived than the fluctuations of mood shown in depression. Motor restlessness frequently amounts to wanderlust.

The confusional state differs from the same condition in hysteria and various neuroses and psychoses by special peculiarities which comprise the following: alteration of consciousness is manifested by a disturbance of ideation in which new or recent sense impressions are confounded with old recollection pictures; as a result the thought train is continually digressing and fancies change in kaleidoscopic fashion, and through incoherence and flight of ideas a delirium comes about. In some cases there is for a long time nothing to attract the attention beyond the interpolation of a few meaningless words now and then. The loosening of the associated connection of ideas brings about speech disturbances that are aphasic or paraphasic, or in which speech is disconnected. Similar behavior is seen in handwriting. Consciousness may be retained, although there is disorientation for space and time. Peripheral irritations, such as needle pricks, heat, and other sensations are perceived. Confusion is one of the transitory disorders and may appear under the same conditions as others already mentioned although it is generally a psychic equivalent.

In a comprehensive review of the earlier literature the author shows that the three fields, primary endowment, the character alteration and the state of stigma and deterioration have been confounded. That epileptic persons suffer from certain forms of mental stigma is certain; the irritability and supersensitiveness are probably a part of the defective endowment of his personality, while the transformation of instincts into an antisocial attitude or into states of excitement and delusions of a persecutory nature shows the gradual decay of these imperfect instincts. The failure in interest, initiative, memory and reasoning power found in the later stages shows a deterioration in the intellectual field; this state is perhaps secondary and not immediately connected with the disease process. Therefore, it is assumed that epilepsy looked at from a purely mental standpoint is not primarily an intellectual disorder but lies in the emotional field. So when the state of deterioration per se is considered, there is considerable difficulty about where to begin. This

state is limited to the decay or breaking down of the defective primary endowment in its emotional or personality aspects and to the final loss of intellectual faculties. The state is called deterioration rather than degeneration or dementia as the latter terms connote organic changes or association with other disease processes.

The author does not find that deterioration is at all dependent on microscopic changes in the brain nor on the number or severity of attacks. The criteria on which a prognosis should be based are: diminution of attacks and improvement in character, conduct and types of occupation. It is found that the single word-association test will reveal the degree of perseveration and the length of reaction time, which are most important in determining the presence and amount of deterioration.

A number of case histories are given in which particular attention is given to convulsive frequency, the clinical evidences of alterations in conduct, behavior or work and the precise analysis of psychologic testing. It is pointed out in these studies that deterioration in epileptic persons is based on the essential make-up, which in turn entails poor adaptation to reality. Then follow increased handicaps, with failures and disappointments which make for a lack of interest in the objectivated task and a turning back of the interest on the patient himself. Next comes the gradual deterioration to a permanent withdrawal from reality.

Efforts to combat deterioration are directed toward building up the interest, first from the patient's self engrossment in order to enable him to enlarge his self interest to that of some occupation, and finally toward implanting in him a spontaneous desire to find satisfaction in the effort without direction. He must have some interest of work or recreation entirely his own, the more individual the better.

HOWARD, Milwaukeee.

EXPERIENCES WITH ENCEPHALOGRAPHY. ADOLF BINGEL, Ztschr. f. d. ges. Neurol. u. Psychiat. **114**:323 (June) 1928.

Bingel records six years' experience with encephalography, which he introduced in 1920, independently of Dandy's contribution on ventriculography. There are three methods of introducing air into the nervous system: (1) by the lumbar route, into the subarachnoid space of the cord, and then by means of the cisternal foramens into the ventricles; (2) by the cranial route, which introduces air directly into the ventricles; (3) by the suboccipital route, which introduces air directly into the cisterna magna. While the suboccipital route is not dangerous, there is some manipulation of the needle in the introduction of air which may cause small hemorrhages that may be serious. Bingel prefers the lumbar or cranial to the cisternal route, but states that it is well to keep in mind that if either of these two are not possible, the third route may be used. Bingel prefers the two needle system in doing encephalography because it causes least variation in pressure. His objection to Wartenberg's technic is that there are great pressure variations by this method. Bingel states fairly that he approves of all the methods, but naturally looks on his own as the best. In comparing ventriculography and encephalography Bingel states that after-effects are present in both procedures, but are more marked in the introduction of air by the lumbar route. This he attributes to a greater flow of spinal fluid by this method, fluid coming from the entire ventricular system, while in ventriculography fluid is removed only from the ventricles. Deaths have been reported in both procedures. Bingel points out definite dangers in encephalography. He says that this should never be performed in cases of cerebellar tumor, and also that in cases of sudden decrease of pressure when the air returns after 60 cc. have been introduced the procedure should be terminated. Bingel reports briefly a few cases which terminated fatally, in order to illustrate the contraindications. In one case of cerebellar tumor, death followed the introduction of air by the lumbar method. He reports briefly another case to show that ventriculography is also dangerous. In this case only a few drops of fluid were obtained from one ventricle, while the other could not be entered.

Bingel therefore lays down the following rules: (1) in cerebellar tumors use only the cranial route; (2) in cerebral tumors, use the cranial approach

primarily, but if one ventricle cannot be tapped wait a few days before tapping the other side, or else use the lumbar route. He advises strongly that a thorough neurologic examination should be made in all cases that require air insufflation, and that the latter procedure should serve only as a further means in diagnosis. Finally, in a consideration of the technic of encephalography, Bingel says that a lack of filling of the ventricles in the introduction of air by the lumbar route is common, but that, on the other hand, the failure of one ventricle to become filled with air while the other is filled is practically always of pathologic significance. He then discusses encephalography in various conditions.

Cerebral Tumors: The size and site of the tumor determine the encephalographic picture. The usual characteristics are a deviation of the ventricular outline toward the healthy side, the deformity, with eventual diminution in size of the ventricle on the side of the tumor, and the dilatation of the ventricle on the normal side. The basal cisterns, in addition, are pressed toward the normal side. The encephalographic picture in frontal tumor differs from that of occipital and temporal tumors. Bingel reports many cases. Taken as a whole, these show the characteristics just mentioned. In one case in which the condition was diagnosed as glioma of the third left frontal convolution the encephalographic observations seemed to indicate a subarachnoid hemorrhage on the left side. Necropsy revealed a glioma of the left cerebral hemisphere. The encephalogram showed a failure of filling of either ventricle, obliteration of the sulci on the left side and a deviation of the falx to the right. He reports a remarkable case of a dural sarcoma in the left parietal lobe. This condition was diagnosed from the encephalogram, showing a lack of filling of the lateral ventricles, a shadow in lateral view corresponding to the tumor, and a large anomalous vessel greatly dilated because of tumor compression. In another case of tumor of the left temporal lobe, Bingel used encephalography to establish the differential diagnosis between a tumor compressing the optic chiasm and one involving the tract. The encephalogram showed a pushing of the ventricle over to the healthy side, a loss of the middle portion of the lateral ventricle, and also a loss of the posterior horn with dilatation of the inferior horn. In a few instances, encephalograms were of great help in diagnosing tumors of the choroid plexus. In one such case the ventricle was filled with air on only one side, while in the other case air was seen widely spread through the right hemisphere due to an internal hydrocephalus caused by a choroid plexus tumor in the ventricle.

Tumors with Hydrocephalus: If a tumor compresses a ventricle or if it obstructs the flow of spinal fluid at the exit of the third ventricle, in or near the aqueduct of Sylvius or the fourth ventricle, there develops a hydrocephalus the extent of which depends not on the size of the tumor, but on the degree of obstruction of the fluid system. As in tumors of the cerebrum, the ventricle on the pathologic side is smaller, while that on the normal side is large. Bingel says that a cerebellar tumor, by pressure through the tentorium, compresses the posterior horn of the ventricle and causes a diminution in size, while the ventricle on the opposite side becomes dilated.

Cerebellar Tumors: The characteristic picture is a dilatation of both ventricles. One may be more enlarged than the other due to more or less complete obstruction on one side. Bingel reports a case of tumor of the left cerebellar hemisphere, in which the left lateral ventricle was less dilated than the right ventricle. As a rule, the fourth ventricle is obliterated. While Bingel has made encephalograms in cases of cerebellar tumor, he advises against its use in such cases because of the great danger from death by pressure of the base of the brain into the foramen magnum.

Hemorrhages: Hemorrhages in and around the brain cause pictures similar to those in tumor of the brain. There is compression of the ventricle on the diseased side and deviation of the ventricle toward the normal side, but there is no dilatation of the ventricle on the normal side. In addition, in many cases there is a more or less severe generalized cortical atrophy which is shown by a dilatation of the sulci and cisterns. The first case which Bingel quotes in this

series illustrates the value of encephalography in these cases. This was a case of meningeal hemorrhage following trauma. There were no signs to indicate the size or the location of the hemorrhage. By means of an encephalogram there was demonstrated a pushing over of the ventricle to one side, a dilatation and deviation of the third ventricle, and a failure of filling of the anterior half of the lateral ventricle. By these conditions it was possible to determine where to operate. Many other cases of vascular accidents are reported.

Paresis: It is characteristic of encephalography in paresis that the introduction of air is extremely well tolerated. There are other characteristics of importance: (1) dilatation of the entire ventricular system, including the third and fourth ventricles (the dilatation of the lateral ventricles is usually asymmetrical); (2) the widening and deepening of the sulci. This is most marked in the frontal lobe, particularly in the region of the fossa sylvii and the insula reilii. In paresis, therefore, there is a reduction in the entire cerebral surface, combined with an internal and an external hydrocephalus.

Tuberculous and Cysticercus Meningitis: In these states there is a more or less pronounced internal hydrocephalus. Only relatively rarely is the hydrocephalus a result of closure of the foramens in the roof of the cisterna magna. In the majority of cases, the encephalogram shows a communicating hydrocephalus. An increased production of fluid, due to stimulation by the bacilli and their products, should give the name "irritative hydrocephalus" to this condition. The form of the ventricles depends on the acuteness of the condition. The younger the patient and the more rapid the rise of the hydrocephalus, the more the ventricles assume their greatest content with smallest surface. They assume a rounded shape. In the hydrocephalus caused by these conditions, there is a dilatation of the entire ventricular system.

Epilepsy: Encephalography should be used as a diagnostic and therapeutic measure much more frequently than has hitherto been the case. From a therapeutic standpoint it has been found to be of value by several writers in decreasing the number and severity of the attacks following its use. From the diagnostic point of view the results are almost as satisfactory. In jacksonian epilepsy, there are definite changes, such as dilatation of the ventricle, asymmetry and deviation of the ventricles and focal collections of air over the cortex. The latter signifies a sinking of the cortex as a result of a superficial or deeply situated focus. These changes are especially well marked following trauma to the skull. In idiopathic epilepsy, Bingel has found only one ventricle filled with air relatively frequently. The changes which are found in encephalography in epilepsy are not uniform, however, and in the cases which Bingel reports there is much variation in the picture.

Striatal Diseases: Bingel has found no changes in the encephalogram in the early stages of striatal disease, but he has in the later stages. The change is a deviation in the angle of the ventricle with the septum pellucidum in fronto-occipital view, while the lateral are more rounded off than usual. Bingel is not certain whether this is a normal condition, or whether it has pathologic significance.

Multiple Sclerosis: Bingel believes that encephalography has no place in this field. In incipient cases there are no changes, and in the later cases encephalography is not necessary. In advanced cases there is ventricular dilatation or asymmetry.

ALPERS, Philadelphia.

THE MALARIAL TREATMENT OF GENERAL PARALYSIS. (A SUMMARY OF GERTSMANN'S MONOGRAPH.) CHARLES O. FIERTZ, State Hosp. Quart. **11**:626 (Aug.) 1926.

Wagner-Jauregg's first steps in the nonspecific treatment of paresis were undertaken in 1888-1889 when attempts were made to transmit erysipelas. These attempts were unsuccessful, as the reaction was local and not systemic. His next efforts, a year later, were with Koch's tuberculin, which gave better results especially when there was simultaneous administration of mercury. Among other agents tried were polyvalent typhoid vaccine of Besredka, which gave good results

in the early stages, and polyvalent staphylococcus vaccine which gave only temporary results. The injection of sodium nucleinate, and the phlogetan treatment of Fisher are now being used, but it is still too early to pass final judgment on them.

The first attempts at malarial inoculation were made in 1917; three of eight patients treated achieved a complete remission, and three continued to hold responsible positions. The remission in one did not come about until a year after treatment. The second attempt, in 1918, was a complete failure as the patients were inoculated with estivo-autumnal instead of tertian parasites, and most of them died. In 1919, this treatment was resumed and since then more than 1,000 patients have been treated.

Indications for Treatment by Malarial Inoculation.—The two points to be considered are: physical condition and duration, and state and form of the paretic disease. If the patient is in an average state of nutrition and strength, malaria can be given without danger. Aortitis, a common complication, is not a contraindication except when there is an aneurysm or chronic myocarditis. High degrees of obesity are mentioned as a contraindication. Patients with tuberculous conditions that had been cured did not show exacerbations, and some patients with active cases received the treatment without bad effects.

Best results were obtained in patients of middle age or older. The early manic, simple demented form and those characterized by convulsions and taboparesis gave the best results.

Choice of Inoculation Material and Precautions to be Observed.—The donor should not come from the tropics because of possibility of contamination with an estivo-autumnal strain. The strain should be pure tertian. After inoculation the blood should be examined frequently for the nature of the parasites. When possible only strains should be used that have gone through several hosts. Two strains were carried through 185 human passages, and they were as curative in the last as in the first inoculation.

Technic of Malarial Inoculation.—The blood is taken from the cubital vein of the donor and without other preparation or manipulation is directly injected. From 2 to 4 cc. is injected subcutaneously into the scapular region. The injection is made deep into the subcutaneous connective tissue, and the needle is moved in various directions making numerous vascular lesions. The blood is infective in all stages of the malaria as long as quinine has not been given.

Preservation of Malarial Blood.—From 3 to 5 cc. of malarial blood is thoroughly mixed with the same amount of a 0.5 per cent solution of sodium citrate. The blood is best taken just after a rise in temperature when youthful and resistive forms of parasites are prevalent. Such blood can be transported or mailed and the infectiousness preserved for from twenty-four to thirty-six hours. A low rather than a high temperature is preferable.

Quantitative Considerations.—A curative dose is considered to be from eight to twelve definite attacks of fever. Strophanthus is given routinely to patients with vascular conditions. A cardiac stimulant is given prior to inoculation and continued for some days after the final attack. Indications for premature interruption of the infection are: sudden collapse, alarming symptoms of cardiac insufficiency and sudden gastric and intestinal symptoms, such as persistent vomiting or profuse diarrhea. When indicated the infection can be modified by small doses of quinine, from 0.1 to 0.2 Gm. given once or repeated after several days. Intravenous injections of typhoid vaccine or sodium nucleinate intramuscularly will cause the infection to reappear, if these small doses of quinine have terminated it.

Interruption of Malaria by Means of Quinine.—Inoculated malaria is exceedingly sensitive to quinine and constantly so. Generally 5 Gm. of quinine bisulphate given twice a day for the first three days and once a day for the four succeeding days is ample to terminate it.

The Question of Specific After-Treatment.—This point is in doubt, but the author's more recent experiments tend to show that malarial infection followed by an arsenical is an advantage.

The Nosologic Individuality of Inoculation Malaria.—The clinical course of inoculated malaria remains unchanged even after numerous successive passages from patient to patient. It differs, however, greatly from that of the natural infection. The course is milder and more benign probably because the propagation in the human host is exclusively of the asexual type and in this way the parasites are less aggressive. The polymorphism of the course of the fever is probably due to the simultaneous entrance by inoculation of parasites in different stages of development. In the natural infection only sporozoites enter the human host through the bite of the anopheles. Enlargement of the liver and spleen seldom takes place and if so only slightly. The number of plasmodia in the blood is relatively small and the pigment less abundant. It has been shown under the most favorable conditions that the mosquito cannot transmit inoculation malaria. A person is not rendered immune after one infection, although subsequent infections may be attenuated.

The clinical results in 400 cases were 33 per cent persistent full remissions, 14.25 per cent other remissions, the patients being able to work but stationary and with residuals. The death rate was 10 per cent. In the remaining cases the infection caused only short remissions or no effect. It was found that the best results were obtained in patients in whom the onset of the disease had occurred from a few months to three years before.

Many neurologic symptoms showed improvement, particularly disorders of speech and writing in most all cases, and frequently serious dysarthria. Convulsive attacks often vanished after treatment, although they may have been more frequent during treatment.

The interval before response to treatment was varied; however, two large groups were distinguishable. In the first, improvement began even during the febrile period and led more or less rapidly to a state of remission. In the second, the improvement did not set in for several weeks or months but gradually reached the same degree of remission.

A relation between clinical and serologic outcome was not found. Improvement of the latter was often delayed several months or even years after a clinical remission. One patient in whom the condition was extreme, and who was treated with tuberculin and mercury had a full remission lasting fifteen years, but still showed most positive serologic reactions.

HOWARD, Milwaukee.

THE ACTION OF LIGHT ON THE EYES: PART III. THE INTERACTION OF RETINAL NEURONES. E. D. ADRIAN and R. MATTHEWS, J. Physiol. **65**:225 (June) 1928.

The optic nerve is unique in that the receptor elements in the retina are connected with the fibers of the nerve through a chain of synapses and neurons. As shown by previous papers of the authors, two features which may depend on synaptic conduction are: (1) a long and variable reaction time, and (2) the dependence of the nerve discharge on the area illuminated, as well as on the intensity of the light. In the present work they discuss synaptic activity of an entirely different kind.

Using an eel's eye, the authors were able to produce a rhythmic discharge of action currents in the optic nerve by an even illumination of the whole or a very large part of the retina. They find that, as a rule, the rhythm does not appear until the light has been on for a few seconds. The highest frequency at which it is fully developed is in the early stages of exposure, when it is about 15 per second; the lowest is after exposure (of about two seconds) and is from 5 to 6 per second. The intensity of the light also affects the rhythm — if increased, the rhythm is quickened. They refer to the work of Fröhlich on the cephalopod eye. He found that the currents led off from the eyeball often show rhythmic oscillations superimposed on the retinal current of the usual type. This rhythm in the cephalopod is higher and may reach 90 per second. The whole retina does not need to be illuminated, but the frequency here again depends on the intensity of the light and declines gradually as the exposure is continued.

The rhythmic discharge is due to a more or less synchronous activity in a large number of the fibers of the optic nerve. Fröhlich considers that the rhythmic discharge of the cephalopod eye is due to fundamental properties of the nervous mechanism, and not to some peculiarity of the antecedent photochemical change. Adrian and Matthews believe that their results, too, were dependent on the natural tendency to rhythmic discharge which is found in so many receptors, and that the synchronous activity of the different neurons was due to nervous interconnection in the synaptic layers of the retina. However, to rule out the possibility of a rhythmic stimulation, they observed the response to a flickering light. When the rate of flicker is 13 per second, the discharge of the optic nerve shows a series of large waves at the same frequency, but a flicker of 15 per second gives a discharge of the usual irregular type without variance in intensity. The fusion point depends both on the intensity of the light and on the size of the retinal image as in man. It is a striking fact that the limiting rate of the rhythmic discharge with the flicker is of the same order as the limiting rates with the steady light.

Strychnine might be expected to favor the development of rhythmic discharges in the optic nerve if these are due to the interaction of the neurons in the retina, and should have no effect if they are due to preliminary photochemical changes. Adrian and Matthews cut away the front half of the eye and used a drop of 0.01 per cent of strychnine nitrate in Ringer's solution on the retina. Within a few moments, although the eye remained in darkness, the record of the optic nerve began to show large rhythmic fluctuations at a frequency of from 2 to 4 per second. When light was turned on there was a large discharge of impulses and the rhythm usually disappeared. At a later stage in the action of the drug, there was a more rapid "resting" discharge, and on illumination, after a short period of irregularity, the discharge became rhythmic again at a higher frequency. With very small doses they did not find a resting rhythm but a rhythmic response during illumination as in the normal eye. Thus it appears that the rhythmic discharge is due to the establishment of a nervous connection between the different ganglion cells of the retina, a connection of the same kind as that established under the effect of strychnine between the different motor neurons of the cord.

Their experiments show that the retinal neurons in the eel's eye may become so closely coupled that they work in unison. They also conclude that the reaction time, i. e., the interval between the beginning of the illumination and the beginning of the discharge of the optic nerve, is much shorter when the illuminated area is large. They get the same change, however, by doubling the intensity of the light as by doubling the area, i. e., the reaction time depends simply on the quantity of light reaching the eye without regard to its distribution. If there is summation due to the connection of ganglion cells, strychnine should favor this effect, if it depends on the interaction of a large group of neurons. Four areas were illuminated singly, then together; before the use of strychnine the reaction time of the discharge with all four areas was the same as the fastest reaction time for a single area, but after the use of strychnine the reaction time for the four areas together was much shorter than for any one singly. That is, the areas are no longer acting independently and the separate excitations are summated on their way to the fibers of the optic nerve. The main action of the drug is to produce a great extension of the lateral connections in the nervous layer.

The fact that strychnine does not lead to any shortening of the reaction time for a single area must mean that although it causes a more widespread activity in the synaptic layers, it does not facilitate the transmission of this activity to the fibers of the optic nerve. Thus, although after the use of strychnine the excitation of a small number of receptors may produce an activity of almost the entire extent of the synaptic layers, the rate at which the activity develops is no faster than before and is still dependent on the number of receptors excited and on the intensity of the light.

Adrian and Matthews find that, granted the rhythmic discharge and the interaction of distant points are due to nervous connections between the different elements of the retina, they must regard one or both of the synaptic layers as a

sheet of nervous material capable of acting as a whole, not as a number of independent pathways leading from particular receptors to particular ganglion cells. It seems probable that the rhythmic activity of the ganglion cells is determined by a rhythmic discharge of impulses from the receptor elements of the retina synchronized by the connections in the synaptic layers. It is probable that the rhythm of the discharge of the optic nerve is produced by the same kind of process as that operating in the peripheral sense organs.

They conclude that the process of conduction through the retina has many of the features of conduction in a reflex arc. There is a variable latency depending on a gradual summation of excitations, and the possibility of a widespread irradiation of the excited state in the synaptic layers. Since the ability to produce a synchronous discharge persists throughout the periods of darkness between successive responses, there must be some more or less permanent increase in the power of interaction between the retinal neurons, i. e., more widespread connections must be developed and the factor which promotes them seems to be the repeated activity of the neurons. Thus, the nervous connections in the retina may have many of the properties shown by the gray matter of the central nervous system. In the eel's eye there cannot be an exclusive nervous connection between one group of retinal elements and one ganglion cell; the evidence of interaction in the human eye points to the same conclusion.

ALPERS, Philadelphia.

RESULTS OF MALARIAL THERAPY (WAGNER V. JAUREGG). JULIUS SCHUSTER, Jahrb. f. Psychiat. u. Neurol. **46**:31, 1928.

Up to the end of 1926, 319 patients (201 paretic, 60 tabetic and 58 taboparetic) were subjected to malarial therapy. Of the twenty-seven paretic patients treated in 1920, seven are still able to carry on their previous occupations, ten are able to do light work, eight are institutionalized, and reports are not obtainable in two cases. Ten tabetic patients have good remissions and two taboparetic patients moderately good remissions.

In 1921, seventy-one patients were treated (37 paretic, 20 tabetic and 14 taboparetic). Of these, ten paretic patients are still capable of performing their usual work, ten are in good physical and mental condition, able to do light work, and eight are institutionalized. In all the tabetic patients, the cachexia has disappeared, and every one of them has gained in weight; in ten of these the lancinating pains have disappeared for a considerable period. Eight patients are still in good physical condition. In ten patients, after an improvement of two years, the reappearance of pains and emaciation necessitated a second course of malarial therapy; this was again followed by good results. Of the fourteen taboparetic patients, four still remain in good condition.

In 1922, twenty-seven paretic patients were treated; of these, seven had complete remissions and are still able to do their previous work; eleven had incomplete remissions. Two tabetic patients had complete remissions and are well. Of seven taboparetic patients, two had complete remissions and remain well, and five had partial remissions which lasted three years, after which they had to be subjected to another course of malarial therapy.

In 1923, fifty-six patients were treated (27 paretic, 18 taboparetic and 11 tabetic). Of the twenty-seven paretic patients, only three had complete remissions; fourteen had incomplete remissions, and ten are "home-ridden." Of the eighteen taboparetic patients, eight had moderately good remissions and were able to readjust themselves socially, but only with a limited capacity for work; the remaining taboparetic patients improved only physically. All ten tabetic patients have regained, to a great extent, their usefulness and have lost the lancinating pains, crises and cachexia.

In 1924, forty patients were treated (30 paretic, 7 tabetic and 3 taboparetic). In all of these, malarial therapy was followed by a course of neoarsphenamine (a minimum of 3.5 Gm.). Nine still remain in a complete remission; nineteen have incomplete remissions but are able to remain at home; one reacted to the treatment

with a paranoid excitement during which he also hallucinated and became so violent that he had to be committed to an institution, where his mental state persisted for eight months, after which the delusions disappeared and he was able to return home and attend to the routine duties of a large farm. Three tabetic patients remained free from lancinating pains for eight months, after which the pains gradually reappeared. Four tabetic patients remained free from gastric crises, while all the tabetic patients regained weight and lost the cachexia. In the three taboparetic patients, there occurred moderate remissions with physical improvement and social readjustment, although their capacity to perform their work was only limited; they all presented definite evidences of an intelligence defect.

In 1925, forty-three patients were subjected to treatment with malaria followed by treatment with neoarsphenamine (25 paretic, 7 tabetic and 11 taboparetic). Four paretic patients died, two in anaphylactic shock, one before the development of the malaria and one several months after the malaria had been checked; of the remaining two, one died eight months and the other one year after the treatment, the former of paresis and the latter of a retropharyngeal abscess. Five patients are still having a complete remission; ten, incomplete remissions, and ten show only physical improvement. In the seven tabetic patients, the gastric crises have disappeared and all show remarkable mental and physical improvement. Three taboparetic patients still remain in a complete remission.

Schuster concludes that malarial treatment followed by treatment with neoarsphenamine is the most effectual method of treating paresis, tabes and taboparesis.

KESCHNER, New York.

INVESTIGATION OF THE EPIDURAL SPACE WITH IODIZED OIL. G. SAIZ and M. GORTAN, Ztschr. f. d. ges. Neurol. u. Psychiat. **115**:108 (July) 1928.

While the subarachnoid space is important in the investigation of the nervous system, there are conditions when it is necessary to know the nature of the epidural space. This is normally filled with fatty connective tissue and venous plexuses. It is necessary to know the condition of the vertebrae, as in spondylitis, carcinoma metastases, fractures, tabetic arthropathies and spina bifida occulta, and also in conditions arising in the epidural space itself, as in tumors and granulations. Saiz and Gortan investigated the epidural space in fifteen normal persons and thus established a standard. The technic of puncture of this space is simple. If a lumbar puncture needle is inserted in the back, two slight resistances are felt. The first corresponds to the ventral end of the ligamentum interspinale, and the second to the ligamentum flavum. At the point of penetration of the latter the epidural space is entered. Certain criteria can be used to be more certain: (1) If a lumbar puncture needle is inserted and then the stilet withdrawn, a hissing will be heard as the needle enters the epidural space, due to the sucking in of air. This is not the best method. (2) The method used by the French is to attach a syringe to the lumbar puncture needle, and to have procaine hydrochloride in the end of the needle. While the latter is in tissue it will not be injected, but as soon as the needle enters the epidural space the solution is easily injected, and if the syringe is withdrawn some of the solution will be forced back out of the needle by pressure in the epidural space. (3) The most useful method of determining whether one is in this space, however, was devised by Janzen. He uses a U manometer of glass with a diameter of 2.5 mm. half filled with a liquid. This is attached to a needle and when the needle presses on the dura, the pressure in this septum falls from 1 to 2 cm., while when the epidural space is entered, it falls 1 cm. again.

Iodized oil 40 per cent was introduced into the epidural space in the cervical region in some cases. It rose two or three vertebrae; it descended at least eight and in one instance fifteen vertebrae deep. After introduction, the shadow of the iodized oil is not always constant because it ascends and descends with time, and a few days or weeks after injection it is found to have left by the intervertebral foramens and to have followed along nerve trunks and muscles. On

lumbar injection, the shadow of the iodized oil extended from one to five vertebrae beyond the shadow of injection. In three of six cases the iodized oil descended to the sacral canal. Immediately after injection, the iodized oil appears as a homogeneous mass, and then follows along the course of nerves as in the iodized oil injected in the cervical region. This takes place after a week or so. Sicard found the iodized oil fixed in the epidural space after twenty hours. Thus, in normal persons iodized oil, when introduced by cervical or lumbar route, appears first as a diffuse homogeneous mass at the point of injection, and then spreads both upward and downward; finally, after a week or more, it escapes by the intervertebral foramens and can be seen along the nerves and muscles.

In three pathologic instances, epidural injections of iodized oil were made without conclusive results. Only in one case of spina bifida occulta did the injection reveal a callosity of the dura which was removed at operation.

ALPERS, Philadelphia.

THE CAUSES OF FETAL DEATH IN 144 CASES. A. C. PALMER, Medical Research Council, Special Report Series No. 118, Child Life Investigations, H. M. Stationery Office, London, 1928.

In this monograph the author reports the results of an investigation into the causes of death of children born dead or dying shortly after birth. In 39 of the 144 cases studied, the fetus was macerated; in 99 it was stillborn but not macerated, and in 6 the infants breathed for a short time after birth.

Of the macerated fetuses, fourteen were proved to be syphilitic by the identification of *Spironema pallidum* in the tissues. The organisms were found most frequently in the liver and suprarenal bodies, rarely in the spleen, kidney, lung, thymus and thyroid and seldom in the myocardium, placenta, pancreas or testis. The most important macroscopic indication of syphilis was an increase in the depth of the zones of provisional calcification of the cartilage of the long bones. In eleven of the remaining twenty-five macerated fetuses the cause of death could be ascribed to toxemia of pregnancy as indicated by maternal albuminuria. One case seemed the result of maternal morbus cordis and one of fetal malformation. In twelve cases the cause of death was obscure, but in only one of twelve were the urinary examinations sufficient to exclude maternal albuminuria. Although in this one case systematic urinalysis was done and no albumin was found, yet there was a history of no less than ten preceding pregnancies in which fetal anasarca gave evidence of toxemia of pregnancy.

In ninety-one of the ninety-nine stillborn nonmacerated fetuses the necropsy showed that the fetus had suffered from asphyxia, and in seventy-three of these cases it was the ultimate cause of death. In fifty-five cases the asphyxia was not associated with any other conditions; in seven it was accompanied by hemorrhages into the dura (which, however, were not extensive enough to cause death); in one case there was laceration of the liver, and in seven cases although asphyxia was the cause of death there was fetal malformation or disease. In twelve cases in which there was evidence of asphyxia, death was due apparently to intracranial hemorrhage consequent on excessive molding of the head. In the eight cases in which there was no evidence of asphyxia, death was due to fetal anasarca in three, anencephaly in one and to conditions similar to those that give rise to asphyxia in four. In these ninety-nine cases death was primarily the result of maternal diseases in twenty-six, of fetal disease or malformation in three, and of labor in seventy.

Of the six infants who breathed after delivery, in four there was evidence of asphyxia at necropsy, in two there was no evidence of asphyxia but intracranial hemorrhages showed that one of the causes of asphyxia, namely, excessive pressure on the head, had been present.

Histologic examination of the placenta in ninety-nine cases did not reveal an alteration in structure that was characteristic of any of the maternal or fetal diseases.

PEARSON.

A Peculiar Form of Inflammatory Disease in the Posterior Cranial Fossa. M. Gunther (with a pathologic report by F. Stern), Arch. f. Psychiat. **83**:1 (Feb.) 1928.

Gunther describes a series of cases in which the course of the disease and clinical observations showed sufficiently consistent characteristics to be considered as a separate entity. In all these cases the onset was insidious, coming on more or less gradually. The family history and previous personal history were without significance. The first symptom was headache; following this there were various symptoms indicative of involvements of the cranial nerves: double vision, deafness, vertigo, dysphagia, etc. The neurologic examination of these patients showed, in all but one, a characteristic picture of multiple unilateral involvement of the cranial nerves, most of these being limited to the nerves in the posterior fossa. In one case, there was bilateral involvement. Only two cases showed a slight involvement of the pyramidal tract, and there were few symptoms pointing to the involvement of any other part of the central nervous system. There were no involvements of the other organs, no fever and no indications pointing to a possible etiology. The spinal fluid showed a slight increase in cell count in only one case, and there were no signs of increased intracranial pressure.

A discussion of the differential diagnosis is undertaken with special reference to new growths and inflammatory processes at the base of the brain. The absence of signs of increased intracranial pressure (considering the fact that one is dealing with posterior fossa lesions) would differentiate it from the first, whereas negative serologic observations would distinguish it from the second. In the case that showed bilateral involvement and, therefore, to a certain extent differed from the others, the disease ended fatally, and an autopsy was performed. The observations, which are reported completely by Stern, were those of an infiltrative radiculomeningitis. Of the other five cases, two patients recovered completely and three have improved without complete recovery. Because of the similarity between the clinical picture in the case that was examined histologically and the other five cases the authors assume that the probable pathologic changes in all these cases is a circumscribed form of an infiltrative basal meningitis and perineuritis.

Malamud, Foxborough, Mass.

The Treatment of General Paralysis. With Special Reference to Tryparsamide and Malarial Treatment. George H. Kirby, State Hosp. Quart. **11**:559 (Aug.) 1926.

One hundred and twelve patients with paresis representing all stages and clinical varieties of the disease were treated with malaria. The same strain of tertian malaria was used in all cases, and the patients were allowed to have eight, ten or twelve attacks of febrile paroxysms. Eighty-two per cent of the 470 patients with paroxysms had a temperature of 104 F. or higher; 69 per cent, 105 F. or higher and 47 per cent, 106 F. or higher. There were 32 per cent of complete remissions, and 14 per cent of moderate remissions, in which the patient showed great improvement and disappearance of all psychotic symptoms but had lack of insight or somewhat lessened capacity for work. Ten per cent of the patients were improved; 25 per cent unimproved, and 19 per cent, or 21 patients, died. Eight patients died during the course of the malarial fever; three died from one to three weeks after the completion of treatment. The other ten died from one to ten months later and the malaria probably was not the cause of death.

The author believes that artificial malaria cannot be transmitted by mosquitoes as the gametocytes disappear from the blood after the first few passages of the malaria from person to person. This eliminates the mosquito phase, and the parasite reproduces only in nonsexual forms. In a three year period the treatment of paresis with tryparsamide and malaria has resulted in an increase of 105 per cent in paroles from ten New York State Hospitals. In five hospitals, most active in the treatment of general paralysis, the increase in cases on parole has been nearly 200 per cent in the same period.

Howard, Milwaukee.

PAGET'S DISEASE LIMITED TO THE CRANIAL BONES ASSOCIATED WITH FRONTAL LOBE SYMPTOMS AND A KORSAKOFF SYMPTOM-COMPLEX. JAN H. VAN EEDEN, Jahrb. f. Psychiat. u. Neurol. **46**:53, 1928.

A woman, aged 62, began to have attacks of vertigo at the age of 47; in 1920, her vision became impaired in both eyes; in the fall of 1923, she developed frontal headaches, more frequent attacks of vertigo, propulsive gait and, later, marked disturbances of equilibrium and asynergia with incontinence. Clinically, as well as roentgenologically, there were evidences of Paget's disease, which was strictly limited to the cranial bones. She also showed slight hypomimia, limitation of upward gaze, left-sided deafness (probably due to otosclerosis) and a questionable diminution of labyrinthine irritability on the left side; ophthalmoscopically, there was bilateral optic neuritis with beginning papilledema on the left side. There were cerebellar signs in the fingers and hands, more marked on the left side, and during passive motion there was some hypertonicity of all joints, also more marked on the left. Toward the end of the disease there was a positive Laségue sign (it is not stated on which side). Except for some transitory improvement in the mental state during the spring, 1925, the mental picture is described as follows: Slight euphoria without variations and without hyperaffectivity, a striking lack of spontaneity and functional capacity with a marked memory defect but no actual disturbance of intelligence. Although there was no true confabulation, the patient was extremely suggestible. Attention was also markedly diminished, as was orientation.

The author does not state the outcome in the case. The remaining part of the paper is devoted to a review of the literature, especially as to the diagnosis of Paget's disease and to the occurrence of mental symptoms in this and in other organic diseases of the brain.

KESCHNER, New York.

APPLICATION OF HYPOPHYSEAL PUNCTURE IN MAN. A. SIMONS and C. HIRSCHMANN, Der Nervenarzt **1**:73, 1928.

As a result of the difficulty in making a positive differential diagnosis in patients presenting pituitary syndromes, Simons and Hirschmann have developed a method for hypophyseal puncture. The technic of this method is discussed fully. The authors thus far have performed the puncture twenty times, on eight different patients. In the first patient on whom the puncture was tried, syphilis and a pituitary cyst had to be differentiated. In this case, two successful punctures were made without ill effects. In each instance a clear fluid was aspirated, which was rich in albumin. Six days after the second puncture, Krause explored the pituitary area, but found only the remnants of a cystic degeneration. Nine weeks later the patient died of cardiac insufficiency. At necropsy, a chronic leptomeningitis was found, which was probably syphilitic in character. There was also a degenerating cyst which had excavated the sella and had extended into the substance of the brain. In the work of the authors, serious after-effects have not occurred from this procedure. Occasionally, pains about the face will present themselves, but beyond these so-called physiologic complications, ill effects have not been observed.

It is the authors' contention that this puncture should be attempted only when it is important to make a differential diagnosis, that the procedure must be considered to entail some danger, but that it is no more serious a procedure than the removal of a brain cylinder. In view of the rather unfavorable surgical results in pituitary tumors, the possibility is also suggested that, by means of hypophyseal puncture, chemical agents, or, possibly, radium needles, may be inserted directly into the growth and thus obviate more extensive surgical intervention.

MOERSCH, Rochester, Minn.

IODIDE PENETRATION AND EXCRETION THROUGH THE URINARY SYSTEM IN PSYCHOSES. HANS HOFF and ERWIN STRANSKY, Jahrb. f. Psychiat. u. Neurol. **46**:9, 1928.

1. In melancholia, inorganic iodide is retained in the organism longer than normally and is excreted through the urine slower than in nonpsychotic and nonsyphilitic patients. In mania, the renal excretion of this form of iodide is characteristically more rapid than normally. The mode of excretion of this compound, in contrast to other substances, is apparently independent of the psychomotor state. It would seem then that disturbances in iodide metabolism play an important rôle in manic-depressive insanity.

2. In schizophrenia, the variations in the curve of iodide excretion do not seem to bear a relation to the symptomatic picture of the disease (either psychomotor or affective); the "atactic" character of the curve harmonizes with the "atactic" character of the psychic disturbance; both of these may possibly be due to a basic dysfunction of the same endocrine glands.

3. Chronic syphilitic and paretic patients show a tendency to iodide retention somewhat analogous to that observed in melancholia. Whether or not this phenomenon bears any relation to a functional disturbance of the thyroid gland cannot be determined at this time.

4. Characteristic curves were not obtained in the other psychoses (arteriosclerotic); nevertheless, they differed definitely from those obtained in the other groups.

KESCHNER, New York.

EFFECTS OF VARIATION IN INTENSITY AND FREQUENCY ON THE CONTRACTIONS OF THE STOMACH OBTAINED BY STIMULATION OF THE VAGUS NERVE. B. A. MCSWINEY and W. J. WADGE, J. Physiol. **65**:350 (Aug.) 1928.

Experiments were carried out to investigate the relation between the response of the stomach to different types of vagal stimulation and the condition of tonus in the smooth muscle. Cats were anesthetized with phenobarbital or with ether and phenobarbital, and the records of the movements of the stomach were taken by means of a stomach tube introduced through the cervical esophagus and attached to a water manometer. The pylorus was ligated. The vagus nerves were isolated and divided in the neck, and the peripheral end was stimulated with induction shocks of different frequencies and intensities.

When the vagus nerves were stimulated in the neck, the left usually caused a greater effect than the right, and the greatest effect was caused by stimulation of both together. Independent of the type of current, stimulation of the nerves with the stomach in a condition of low tonus always caused contraction of the stomach. By frequent stimulation the stomach could be raised from a condition of low to one of high tonus. In all experiments, stimulation of the nerves with the stomach in a condition of high tonus caused relaxation of the stomach.

McSwiney and Wadge conclude that the response of the stomach to vagus stimulation does not depend on the frequency and intensity of the stimulus, as suggested by Veach, but on the condition of the peripheral mechanism; high tonus predisposes to an inhibitor, low tonus to a motor response.

ALPERS, Philadelphia.

SPEECH ITERATION AND ITS LOCALIZATION IN FOCAL LESIONS OF THE BRAIN. ARNOLD MERZBACH, J. f. Psychol. u. Neurol. **36**:210, 1928.

According to Kleist, extrapyramidal disturbances of motility due to lesions of the basal ganglia consist of (higher) psychomotor and (more primitive) myostatic and dyskinetic phenomena. Extrapyramidal disturbances of motility also affect speech, although clinically it is difficult to distinguish these speech disturbances from those due to cortical lesions. The most definite speech disturbance of extrapyramidal origin, next to speech parakinesia, is speech iteration. Parakinesia and iteration belong to those manifestations of psychomotor restlessness which are due

to disturbances of striated musculature from actual involvement of the caudate nucleus. In a series of sixty-six cases with motor iteration and striatal lesions studied clinically and anatomically in the Frankfurter Psychiatric and Nerve Clinic there were only twenty-four cases of speech iteration. From this study, the author concludes that there is no doubt that speech iteration is due to lesions in the striatum. A case of speech iteration was not observed in pure cortical involvement. The most ventral portion of the caudate nucleus (the head) is, physiologically, the site for the regulation of speech. There is also no doubt that there is some relationship between speech and the ventral portion of the putamen. This is in harmony with the somatotopic division of the striatum described by C. Vogt and O. Vogt. Although one large lesion in either caudate nucleus is sufficient to give rise to speech disturbances, nevertheless, in most of the cases the lesion in the caudatum was on the left side.

KESCHNER, New York.

THE ROENTGEN RAY AS AN AID IN THE INJECTION OF THE SPHENOPALATINE GANGLION. O. H. HOMME, Arch. Otolaryng. **7**:553 (June) 1928.

Studies were made with the x-ray to identify the position of the pterygopalatine canal and the sphenopalatine foramen, the results of which led to the conclusion that a slightly curved needle would more closely approximate the lateral wall of the nose. The curved needle is less likely to pass laterally out of the pterygopalatine canal into the infratemporal fossa. On introduction, the concave side of the needle faces medially. Views are shown to illustrate that a roentgenogram, read at the time of the insertion of the needle, would aid greatly in the elimination of the danger of passing the needle too high in the pterygopalatine canal. Needles may easily go into the pterygopalatine, then laterally out of the canal to impinge in the infratemporal fossa. Needles may be passed by both the Sluder and the Ruskin methods, and an x-ray picture may be taken, the one in the best position being selected, although the author would not advise this in every case.

Homme concludes that: (1) In lateral views of the head, the pterygopalatine canal and the sphenopalatine foramen can be distinguished. (2) The region of the sphenopalatine ganglion is more definitely determined by the aid of anteroposterior and lateral roentgenograms taken with a needle through the posterior and the middle turbinate and with one in the pterygopalatine canal. (3) The region of the ganglion is more nearly approached by using a slightly curved needle in place of a straight needle in the pterygopalatine canal.

HUNTER, Philadelphia.

ACROMEGALY AND DIABETES. WALLACE M. YATER, Arch. Int. Med. **41**:883 (June) 1928.

Six cases are reported of the combination of acromegaly and diabetes, in three of which insulin was required. This diabetes was in all essential respects similar to the ordinary form and responded similarly to diet and to insulin therapy. Three of the cases presented the unique complication of increased basal metabolic rate, presumably due to hyperthyroidism, and thus raise the question again of the interrelations of the pituitary and thyroid glands. The assumption that diabetes associated with acromegaly is due to the same cause which produces the acromegaly derives its support from the following: (1) Acromegaly is frequently associated with typical diabetes; (2) hypopituitarism is infrequently associated with diabetes; (3) even though hypophysectomy in man has never been followed by a cure of the diabetic condition, it has been followed by a state of increased sugar tolerance; (4) even without diabetes, sugar tolerance may be diminished in acromegaly; (5) transient hyperglycemia and glycosuria may be produced by the injection of pituitary extracts, and (6) pituitary extract can prevent or relieve the hypoglycemia and convulsions from the effects of insulin. The only difference between diabetes alone and that associated with acromegaly is its occasional spontaneous, temporary or permanent disappearance.

ANDERSON, Philadelphia.

Society Transactions

KAISER WILHELM SOCIETY FOR THE ADVANCEMENT OF SCIENCE

STANLEY COBB, M.D., *Reporter*

Dedication of the Institute for Research in Psychiatry in Munich

Munich, June 12-13, 1928

The annual meeting was held this year in Munich in order to take over officially the new "Deutsche Forschunganstalt für Psychiatrie" as a Kaiser Wilhelm Institute. The first morning was taken up with a review of the year's progress by President von Harnack. He told of the work of the thirty-two research institutes of the Society, especially mentioning that done by the Institute for Industrial Physiology. He told of the new buildings planned for the Institute for Brain Anatomy. These are to be in close connection with a great hospital in the suburbs of Berlin, and will give Professor Vogt and his co-workers much better facilities than they now possess. A new institute is being built for anthropology in Berlin, and one for agriculture in Müncheberg. Plans are being drawn for an important medical institute in Heidelberg where physics, chemistry and physiology can be closely associated with clinical problems.

The Rector of the University, Prof. Dr. Schüpfer, then welcomed the Society to the University of Munich. After this, three lectures were delivered on scientific subjects: one on "The Mechanical Problem of Development," an embryologic paper by Dr. O. Mangold; a paper on "International Regulation of Citizenship" by Professor Triepel, and the last on "Thirty Years of Radium Research" by Professor Hahn. In the afternoon, the members were asked to visit the German Museum. In the evening there was a brilliant dinner, with many speeches, at the Bayerische Hof.

DEDICATION OF THE DEUTSCHE FORSCHUNGANSTALT FÜR PSYCHIATRIE, JUNE 13, 1928.

This was indeed a red letter day for psychiatry, a day rich in history and reminiscences of the past accomplishments of German psychiatry and full of hope for the new era. The meeting was held in the new building on Kraepelin Strasse, and the room was full of scientists from all Germany and psychiatrists from many countries. The new building is a five-story structure containing about 100 rooms. As will be described in Professor Plaut's speech, the organization is to be elastic and to change as new needs arise. At present the ground floor is given over to Professor Rüdin's work on inheritance. Here one finds rooms for the anthropologic study of patients, and other rooms full of data on the families of patients, data on the geographical distribution of nervous and mental diseases, and a personnel trained in statistical methods. On the next floor are the laboratories of Professor Plaut where he carries on his well-known serologic studies and experiments with the inoculation of syphilis in animals. Here also is the department of Professor Jahnel where bacteriologic work, especially on spirochetes, is in progress. One corner of both these floors is taken up by a small and well equipped lecture room. Above, on the third story, is the anatomic and histopathologic department under the direction of Professor Spielmeyer. Here are the remarkable collections of Nissl and Alzheimer, and the mass of new material collected by Spielmeyer. There is close contact with the psychiatric service of Professor Lange in the nearby Swabinger Krankenhaus, and Professor Oberndorfer, the pathologist there, sends over his neurologic material. At the time of the celebration there was an active group of eleven young neuropathologists

already studying in this laboratory; three Germans, three Americans, a Swiss, a Bulgarian, an Esthonian, a Russian and a Japanese. A laboratory for experimental psychology takes up the south end of this floor. The fourth story contains the library, the reading room and the lunchroom for the workers of the whole building. On this floor is the chemical department which is not yet open, but adequate space is provided and apparatus supplied for an important laboratory. It is hoped that it will be running by early fall. The fifth story at present is used for storage, but there is good space there for future development. In the rear of the building a fine animal house is connected to the institute by a passage. The building itself is a unit, but stands within a few yards of the great general hospital of North Munich, the Schwabinger Krankenhaus, so clinical associations of a high order are assured.

The speakers at these opening exercises were well chosen; they spoke ably and briefly, giving the history and the hopes of the new Institute from many aspects. Unlike many such ceremonies, this meeting was full of interest and feeling. Professor Plaut's speech was a creed to inspire all psychiatrists. The

Deutsche Forschunganstalt für Psychiatrie

announcement of the Kraepelin Medal Award, Spielmeyer's presentation speech and Vogt's answer made a dramatic ending to a great morning.

The meeting was opened at 10 a. m. by Staatsrat Dr. Hauptmann who welcomed the visitors in the name of the Board of Trustees, who have labored so many years to make the new Institute possible. Next, President von Harnack accepted the new building as a Kaiser Wilhelm Institute, voicing a threefold wish: (1) that this new Institute should always be a place of research in the fullest meaning, for research is the foundation of scientific accomplishment; (2) that it may serve as a place for the advancement of cooperative work, and (3) that it would be a starting point for a new epoch in psychiatric therapy, for of all the scourges of mankind mental disease was the worst and the most difficult to deal with.

Dr. Krupp von Bohlen-und-Halbach spoke for the Founders. He told of the 200,000 insane in German hospitals and the great number of harmless psychiatric patients living in the community. Psychiatry was a major issue and had lagged behind other branches of medicine in scientific progress because of moral and religious prejudice; but the fact could not be gainsaid that even this field was being invaded. He described Kraepelin's early struggle to found the Institute, and told of the hard times during the World War and the inflation. He hoped that all those who came to the Institute to work would keep in mind these birth

labors and the courage neccessary to overcome such difficulties. They should also maintain with pride the responsibility to the future of mankind which their high task entailed.

THE GIFT OF THE ROCKEFELLER FOUNDATION TO THE GERMAN RESEARCH INSTITUTE FOR PSYCHIATRY, KAISER WILHELM INSTITUTE, IN MUNICH. PROF. SPIELMEYER.

"I wish to express to the Rockefeller Foundation the thanks of this Institute. In doing so I cannot apostrophise delegates from the Rockefeller Foundation, for it is their custom to have their members remain aloof from the dedications of institutes which they have aided.

"We especially appreciate how finely the Foundation understands giving: in our dealings with them, and in the granting of a million-mark contribution, there has never been a question of their influencing in the least the administrative or scientific policies of this Institute. That this reserve is not lack of interest we know from the words of their representative. When the Vice-President of the Rockefeller Foundation was here a few weeks ago inspecting the building and expressing satisfaction over the fine work of Professor Sattler, he assured us that absence of the officers of the Foundation was nothing but a desire to shun public honor. Moreover, the European manager of the Foundation wrote me: 'When the Institute is opened you will have in me an absent friend, one, who among many others in the world, tempers his sorrow over not being able to be in Munich by taking joy in the fruition of your year-long hopes.'

"We receive with great satisfaction this sympathetic thought of the representative of the Rockefeller Foundation on this day, the day on which Kraepelin's work, through their help, has been completed. We thank our German and foreign friends for the proofs of their participation in the final fulfilment of our desires. And even as the Chairman of the Foundation has greeted all you who were good enough to come, so I should like to thank all those who had to stay away, for their sympathy. I welcome warmly those of our foreign friends who have not been deterred by the long journey, but have joined us here at this festival: Professor Marcus of Stockholm and Professor Bouman of Utrecht, and I thank the American Professor Cobb, for I know that his judgment of the work we do here was a factor in facilitating the grant from the Foundation.

"What this magnanimous help from the Rockefeller Foundation means to our Institute and to me is shown by the fact (more clearly than by any words) that it is only through this help that our Institute was able to amalgamate its various scattered departments under one roof. Thus is one condition necessary for the life of our Institute fulfilled. In the periods of our direst need we have always found saviors — you have been told of this by the chairman of our finance committee. But it seemed that in post-war Germany there was no chance of getting the means to carry out our original plan and to give us the much needed home of our own. We have only this American aid to thank for freeing us from the inadequacy of the provisional arrangement and from the danger to our independence. On this day, when we have reached our goal, we think of the experts and the Director of the Rockefeller Foundation who first listened to Kraepelin when he outlined the needs and goal of his Institute. We want to bear witness for him that he himself longed for the crowning of his life's work and the building of the Institute by the help of the Rockefeller Foundation. On his deathbed he said that it was his 'last great hope' that this might come to pass. So with all thankfulness we name the men who have taken part so vigorously in supporting Kraepelin's work: the President of the Foundation, Dr. Vincent, Dr. Abraham Flexner, Dr. Pearce, the European Director, Dr. Gregg, Prof. Woods and Pres. Haughton.

"The gift of the Rockefeller Foundation is an approval of our work and hence involves a high duty. We accept this heartily and with the firm intention of fulfilling the duty insofar as our strength allows. We thank the trustees that the donation of this great gift is tied up with no conditions other than those which seem to put our work on a safe basis for success: namely, upholding the general

plan just as it was presented to the experts of the Foundation, and holding true to the fundamental ideas of Kraepelin.

"With our thanks we may express our wonder at the extraordinary organization of the Rockefeller Foundation. It gives donations from the private riches of a high-minded philanthropist. These are given with the most idealistic aims, and are divided without prejudice among the people of the earth, never asking about nation or race."

Professor Spielmeyer then went on to tell of the philanthropies of John D. Rockefeller. He described the Rockefeller Institute for Medical Research, the General Education Board, the Rockefeller Foundation, and the Laura Spelman Rockefeller Memorial. He told how carefully the gifts were given, and mentioned the great sums donated to education, research, medicine and the like. The gift to the "Deutsche Forschungsanstalt für Psychiatrie in Munich" was named as $325,000. (At this point the reporter heard many exclamations in the audience — "What? *Dollars!*") The speaker then described the special work of the General Health Board, its attacks on hookworm, yellow fever and malaria, ending with: "The more deeply one looks into their activities, the more one sees how carefully they follow the example of the donor in circumspection and boldness of conception. One becomes aware of how much this means for the peace of the world, that the roots of such a philanthropy should be deeply fixed in one nation but that it should spread its benefits to all mankind and enrich the world." He closed with a quotation from Dr. Vincent's annual report, a little essay on the "by-products of team work."

SOME OF KRAEPELIN'S FUNDAMENTAL CONCEPTIONS CONCERNING THE "DEUTSCHE FORSCHUNGSANSTALT FÜR PSYCHIATRIE." PROF. PLAUT.

"This Institute, the de[illegible]ation of which we celebrate today, is Emil Kraepelin's Institute. It is the result of his life's work, and bears in all its details the mark of his personality. There are few research institutes in the world which are so closely connected with the name of the founder, so personally stamped, as ours. The Pasteur Institute in Paris and the Koch Institute in Berlin have such a personal stamp. Pasteur and Koch, however, were destined to work long years in their Institutes; fate gave Kraepelin only time to draw up the plans of his. It is a great sorrow to all of us that Kraepelin is today no longer with us to take possession of his house.

"So it is the duty of us, his old co-workers, to carry on his work and to fill this workshop with his spirit. We could scarcely hope to enter into this inheritance with prospect of success were it not that we have been initiated into the master's plans by decades of work with him, so that we could know his slightest wish. Allow me to describe in a few words how Kraepelin had conceived the work of the Institute:

"This Institute was to be a foster-mother to the sciences related to clinical psychiatry. Just those subjects which only came near to the psychiatric clinic, and could not be supported in an adequate way, are to be the chief concern here, i. e., anatomy, physiology and biology, especially histopathology, serology, experimental therapy, microbiology, chemistry and heredity. So shall the different sides of the common enemy be attacked.

"The Institute is a laboratory building without space for patients. The work, however, would soon atrophy and become lifeless if it could not take a lasting and active interest in a rich clinical material. With this in view Kraepelin arranged with the city of Munich, even ten years ago, that a great clinical department should be established near the Research Institute. We are happy to say that the city is preparing to carry out this promise.

"The different departments, according to Kraepelin's project, enjoy complete independence. But with all the independence which he assured to the departments, he held as essential a close community of work, for he saw in the intimate association of the different departments the prerequisite of success. Each departmental head must be imbued with the importance of unselfish and trustful cooperation. But commands do not go with independent research, so Kraepelin avoided

all compulsion. The departmental heads are equal, at certain periods one of them takes over the administration, as director, for several years, but there is no 'Director,' as in other institutes. Kraepelin wished to avoid all appearance of subordination; the cooperative work must develop freely out of intrinsic devotion to the common goal, out of the conviction that one needs the other.

"The number and kind of departments that the Institute contains should, according to Kraepelin's work, have no rigid and unchangeable form. The organization should remain elastic; the circle should broaden and change according to the need, according to the changes of knowledge with time, according to the personalities of the men obtainable for the work. In the same way lines of work which no longer seem promising should be given up. So it may later come to pass that work for the advancement of psychiatry may be carried on in this building, which is of an entirely different nature from that which we are doing now. And this will be no violation of our respect for Kraepelin, but entirely according to his mind. For Kraepelin always took his stand facing toward the new things; he never stood still; he went with the times and ahead of the times. Wherever he perceived new life he tried to acquire it, and so his Heidelberg clinic, and later his clinic in Munich, was modern in the best sense. To just this scientific tolerance and versatility does this Institute owe its birth.

"A North German psychiatrist once said that Kraepelin and his school were 'toujours en vedette.' So we wish to stand at our posts in the future, not sticking in our narrow rut, but looking into the future, watching the new things carefully and sharply, but not accepting them merely because they are new. Kraepelin tried to take up everything new insofar as it seemed good, but never anything because it was new. So this Institute ought to not only seek new things, but it ought to be a place for criticism, for we take as much pride in being critics as pioneers.

"The danger of losing oneself in the boundless is especially great in the realm of psychiatry. Psychiatry is the science of sick mentalities; therefore many consider it really a kind of mental science and believe that its problems can only be solved to a very limited extent by the methods of natural science. One must not forget that psychiatry has only very recently become a specialty that can be classified among the natural sciences. It was long in the hands of the philosopher. Scarcely a hundred years have gone by since they had viewpoints which today seem to us entirely absurd; mental disease was a punishment for moral guilt, an adjudged expiation for past sins. Only in the nineteenth century did psychiatry free herself from these bonds, only then did she again grasp the medical points of view, and take for herself the conception that mental disease is brain disease. Then the technic of natural science penetrated psychiatric teaching and led to many victories. But only in certain directions was this progress rapid and convincing. That all questions do not lend themselves equally to solution by the methods of natural science — that for some it may never be possible — makes many men faint hearted and faltering. Hopes were for a while raised to an exaggerated pitch by partial results; set-backs came, and not a few denied that scientific psychiatry could progress further, and turned away from what one might call this materialistic approach. We stand in the midst of this movement which has really more or less taken hold of all medicine. Objective research, as they say, only supplies the poor piece-work, it does not divine the great relationships. Only the intuitive conception, the direct perception, leads to the essence of things.

"Kraepelin saw this wave approaching and it frightened him not at all. For he knew the history of science well enough to know that mankind always underwent, from time to time, a debauch of knowledge which overflowed the sober and slowly progressing research work. Indeed Kraepelin's beginnings were in a time when just such a vitalistic wave had ebbed.

"Kraepelin was full of respect for the unexplorable. But he was convinced that what was explorable in psychiatry was to be investigated by the way of natural science. We share Kraepelin's confidence that still wider fields in psychiatry are open to objective research, so that in an appreciable time there will be no lack of work, and, we hope, of results. When, at last, clinical research — in the form which Kraepelin regarded as research — joins with its adjuvant

sciences, then may the sublime judgment come and set the cupola on the building. That will, however, be still a long while hence. Meanwhile let those spirited fellows, who chase distant goals without steering gear or brakes, nimbly romp along — but outside our walls.

"For the work in this house, then, Kraepelin has set the task: to investigate the structure and function of psychopathologic phenomena by the methods of natural science, and to combat mental disease with the results. To this fundamental we will hold true and champion it unswervingly as Kraepelin's legacy."

The Minister of Education, Dr. Goldenberger, spoke next in behalf of the Bavarian Government, telling of their interest in the project since its beginning and promising continued support. He was followed by Oberburgermeister Scharnage, representing the city of Munich, which, he said, had been proud of Kraepelin and was now proud to have an Institute fathered by his spirit and supported by so many different interests. He was especially pleased that the Kaiser Wilhelm Society had taken it over.

Professor Borst congratulated the Institute on its new home. His was a most humorous and bright speech, carrying off a somewhat difficult situation in fine style, for he spoke for the Medical Faculty, many of whom are strongly opposed to the foundation of the independent research institutes, believing that research should be carried on in the university departments by the professors who have the responsibility of teaching the students. Professor Borst spoke of the new Institute as their beloved foster-child, who now had come of age, and was leaving the home. They loved her still, and wished her God-speed, but would sorrow at her going. Her duty to live up to her title of Research Institute was not light.

Professor Bumke next presented the good wishes of the German and Bavarian Psychiatric Societies. He was followed by Professor Marcus, of Stockholm, who emphasized that the Institute would not only be a home for German investigation, but would shed light for the psychiatric research of the whole world; it had already enlightened his own land. He brought the good wishes of the University of Stockholm and of the Swedish Medical Society. As a memento he presented to the Institute a beautiful book in which workers in the laboratories and visitors were to inscribe their names.

The last event on the morning program was the presentation of the Kraepelin Prize Medal. No one knew to whom it would be given, so when Professor Bouman of Utrecht arose there was a stir of renewed interest. He spoke for the International Committee which had raised a considerable sum of money to honor Kraepelin's seventieth birthday. The original purpose was to use this as a contribution to the new building, then only partly planned. The great gift of the Rockefeller Foundation had made this unnecessary so the committee had decided to found a Kraepelin prize. One part of this was to be in the form of a scholarship to some gifted young research worker, the other was a gold medal which should only be presented for conspicuously meritorious research in the field of psychiatry. He asked Professor Spielmeyer, as a member of the committee of the Institute, to present the medal for the first time.

Professor Spielmeyer arose and, in a silence tense with interest, spoke as follows:

"I thank you, Professor Bouman, for your good wishes to our Institute, and I thank you personally for choosing me to present the Kraepelin medal. The international committee that was formed four years ago to celebrate Kraepelin's seventieth birthday wishes to bestow a prize in memory of Kraepelin. So Professor Oskar Vogt, director of the Kaiser Wilhelm Institute for Brain Research, was unanimously chosen. (Professor Vogt, who was entirely ignorant of what was coming, stood up, and faced Professor Spielmeyer. This effect was most dramatic and the audience was obviously moved.) The knowledge of your researches, Dr. Vogt, of your researches into the finest architectural differences of the cerebral cortex, is now widespread, since you have in the latter years undertaken to study the differences in individual brains, in the genius and in the criminal. But better than the interest of the 'unknown crowd' was the approbation that came to you at a time when specialists made it a point not to bother with

the results of your work, and either did not understand it or intentionally overlooked it. Then, more than twenty-five years ago, Kraepelin recognized the worth of your quiet research and farseeing ideas. Although he worked at his clinical tasks he always had high hopes for the deepening of psychiatric knowledge through natural science. Indeed from this conviction came his creation — the Research Institute for Psychiatry. Knowing the meaning of your work for psychiatry he was an early admirer of your labors, as we are now.

"Thus has the first award of the Kraepelin Prize fallen to you, Dr. Vogt. You are known in the world as the founder of our knowledge of the architectural organization of the cerebral cortex. You have given us our first scientific orientation, so that we may find our way in the cortex, that complicated and psychologically important part of the central nervous system. Moreover, since the special morphology of these parts of the brain corresponds to special reactions, you have given us, by the areas and layers which you have outlined, the structural basis for the understanding of function.

"For this most important and original part of your rich life-work you receive the Kraepelin Prize. Your learned life-companion, Cecile Vogt, has taken a great part in these decades of careful work. And with her name let me mention also that of your famous co-worker, Brodmann, who was to have taken over the architectonic work in our Institute, but whom death so soon took from us. It will delight you to know that one of the committee of judges, Dr. Ariens Kappers of Amsterdam, wished to remember Brodmann on this day by arranging a large donation for Brodmann's son who, when scarcely 1 year old, lost both father and mother.

"In receiving the Kraepelin medal, Dr. Vogt, you have a beautiful work of art. For this you may thank Professor Georgii who made it. Dr. Loeb originated the idea for the design on the face — you see there a man carrying a burning torch which he is handing to another. On the edge are Greek words meaning: 'Who bears the light, passes it on to another.' May your knowledge light the way for many, and ever continue to cast its rays on us."

In answer to this Professor Vogt, evidently deeply moved, stepped to the platform and thanked the donators for the honor and great encouragement. Without such amenities life would not be worth living, and the symbol on the medal gave him spirit to go on his chosen way. He described his work and how it aimed at the same goal as Kraepelin's, although their methods of approach were so different.

After the meeting there was an inspection of the different laboratories and rooms of the new building. The guests were then invited to luncheon by Dr. and Mrs. Krupp von Bohlen-und-Halbach at Starnberg. The meal was served in rooms overlooking the lake, where the June sunshine sparkled on the water and mingled with the reflections of the Alps. In the evening an entertainment was given in the hall of the old Rathaus, draped with ancient guild banners.

NEW YORK NEUROLOGICAL SOCIETY

Regular Meeting, Oct. 2, 1928

GEORGE H. KIRBY, M.D., *President, in the Chair*

A CASE OF ATYPICAL JUVENILE PAGET'S DISEASE WITH INVOLVEMENT OF THE CRANIAL NERVES. LANTERN ILLUSTRATIONS. DR. MURIEL IVIMEY (by invitation).

A boy, aged 11 years, of Russian Jewish stock, came to the outpatient department of the New York Neurological Institute with complaints of almost total blindness, partial deafness and enlargement and deformity of the face and skull. Defective vision in the right eye dated from early childhood and in the left eye

from about 6 years of age. The defect progressed until 8 years of age when the child became partially blind. Enlargement of the right side of the face was noted in the first year of life; it progressed slowly and steadily until it included the right side of the cranium and occiput and part of the left side of the skull. Deafness was noted only a short time before presentation. The patient was normal at birth and developed normally except for the conditions noted; he suffered one convulsive attack at 3 years of age. He had not had a serious illness, accidents or operations. He was well and active, attended a school for the blind, and was handicapped only by blindness. The family history was unimportant. He was the youngest in a fraternity of four.

The intelligence quotient was 142. The patient was a little taller and heavier than the average boy of his age, and was in other respects normally developed. Asymmetry and deformity of the face and skull were conspicuous, especially on the right side, due to bony masses which merged gradually into relatively normal contours. There was bilateral proptosis; the right eyeball was dislocated laterally; the hard palate encroached on the buccal cavity on the right side, and there was marked thickening of the malar bones, especially those on the right. There was a nevus over the nape of the neck on the right side. The right arm and leg were longer than the left and there was an abnormal angulation at the hip and knee. There was not a true hemihypertrophy, or enlargement of all tissue elements, of the right side of the body. Bilateral primary optic atrophy and partial nerve deafness on the right side were found, and a reduction of vestibular irritability on both sides. The neural status was otherwise normal.

A mild secondary anemia was present; the blood gave a normal reaction and the Wassermann reaction of the cerebrospinal fluid and blood was negative. Tolerance for dextrose and basal metabolism were within normal limits. Habits of eating and sleeping were normal; the intake and output of water were within normal limits. X-ray examination showed the dense overgrowth of the bones of the face and skull characteristic of leontiasis ossea; this condition was more marked on the right side of the face and occiput. Certain areas of the skull had the characteristic fluffy, moth-eaten appearance associated with Paget's disease. The frontal bone showed areas of decreased density and small cystic formations. The sella was small as compared with the skull and may have been larger originally, but at the time of presentation, it seemed encroached on by bony overgrowth. The right humerus, radius, ulna, phalanges, metacarpals, femur, tibia, fibula, the right half of the pelvis and the lumbar vertebrae showed a fibrous bony overgrowth; in the long bones there was thinning of the cortex and enlargement of the medullary canals with areas of decreased density suggesting the formation of cysts. The epiphyses were uninvolved; the articular surfaces, except in the right hip, were not involved. Thus, in the field of early development there was gross clinical and x-ray evidence of leontiasis ossea; the bones of the vault had the appearance of Paget's disease, and the long bones, the field of later development, suggested osteitis fibrosa cystica of von Recklinghausen.

Some students of bone pathology believe that Paget's disease and leontiasis are due to the same process and cannot be differentiated microscopically; also that von Recklinghausen sought to place Paget's disease in the same category with osteitis fibrosa cystica. It is thought that the case reported shows the progression and transition from the condition of diffuse hyperostosis of the face and skull and osteitis deformans to that of osteitis fibrosa cystica. It is suggested that the observations show a trophic disturbance of the bones dependent on some hypothetic primary disease of trophic centers in the central nervous system. In the absence of related symptoms and signs, a clue to localization seemed lacking; it was not thought possible to support or discredit recent work in which a tentative localization was made in the floor of the third ventricle of the brain.

DISCUSSION

DR. C. W. SCHWARTZ: I also had an opportunity to see this patient. I believe that all these bone diseases blend in such a manner that it is difficult to differentiate them. In fact, I believe they can all be classified as malacias. I will show a few

cases which illustrate typical bone changes occurring in the diseases mentioned. The first film is that of a typical case of Paget's disease, and the second shows a case of Paget's disease of the nodular type, two forms not easily differentiated. The third is a typical case of leontiasis ossea with massive, heavy bones. Dr. Ivimey's case has the characteristics of all of these. I do not think one can choose a definite point of differentiation. The difference between this patient's leg and that in a typical case of Paget's disease is clear. Paget's disease does not show the clearcut, thin cortex evident in the lantern slide; it is more a diffuse overgrowth of the trabeculae, not apparent in the case presented. The changes in the skull, however, are characteristic of Paget's disease.

CHANGES IN THE OCULAR FUNDUS IN EPIDEMIC ENCEPHALITIS. DR. S. ROTHENBERG.

I have observed a series of nine cases with the predominating physical observations of changes in the ocular fundus and amblyopia, with further symptomatology which indicated epidemic encephalitis. All the cases occurred within a period of two years; one often succeeded another in a few weeks. The nature of the lesion and the peculiar character of the syndrome manifest in this unusual group of patients gave me the impression that I was dealing with a distinct group of cases heretofore not recorded.

The syndrome consisted of a rather fulminating type of papilledema or amblyopia followed by optic atrophy and some symptoms of either headache, diplopia or mild disturbances of the sensorimotor apparatus such as are often seen in abortive types of epidemic encephalitis. Three of the cases with optic changes began with an acute psychotic condition which lasted for a short time and resembled the mental disturbances attributed to encephalitic psychosis. In three other cases, optic atrophy was present without previous papilledema and was considered to have been a retrobulbar neuritis. One patient was operated on for a tumor of the posterior fossa, with negative results. None of the patients developed any sequelae of encephalitis or any other neurologic condition. With one exception they all recovered and vision either improved or remained the same. One patient presented, besides her amblyopia, a spinal Brown-Séquard syndrome in an unmistakable case of epidemic encephalitis. Another unusual observation in five of the nine cases was the exceptionally low sugar content. The question to be discussed is whether this type of lesion is the usual form of optic neuritis seen in epidemic encephalitis or whether this is a disease process due to some other cause.

DISCUSSION

DR. G. H. HYSLOP: Dr. Rothenberg has an extremely interesting group of cases. I question his logic in assuming that because a certain percentage of patients with epidemic encephalitis show involvement of the optic nerve that all his patients who showed this condition strikingly had epidemic encephalitis. The lack of evidence of involvement of the basal ganglia and midbrain nuclei or of the brain stem, the lack of residuals in every instance, the atypical onset for encephalitis and the centering of symptomatology on the condition of the meningeal tissues, justify only a diagnosis of meningo-encephalitis. I doubt that it is epidemic encephalitis in all instances. In three of his cases the x-ray pictures of the cranial sinuses were reported as normal. Those who have seen many cases of infected sinuses complicated with a serious form of encephalitis or meningitis have found ethmoidal and sphenoidal infection in spite of repeatedly negative x-ray plates and few clinical symptoms. I wonder, therefore, whether some of Dr. Rothenberg's nine cases are not of that type.

Dr. Rothenberg's use of the term retrobulbar neuritis is a little confusing. I think that he is dealing with a neuroretinitis. One might agree that there is a retrobulbar pathology of a parenchymatous type in his cases, but a pure retrobulbar neuritis almost never gives any degree of papilledema or retinal changes. I would suggest to Dr. Rothenberg that he refer to a neuroretinitis rather than to a retrobulbar neuritis.

DR. M. NEUSTAEDTER: I agree that not a single symptom has been shown which might be interpreted as a criterion of epidemic encephalitis; I will go further, however, and say that a criterion of epidemic encephalitis has not yet been published. It is justifiable to label these cases as epidemic or any other form of encephalitis. The absence of sequelae is fortunate for the patients and does not weaken the diagnosis. Twenty-five per cent of all these cases end in recovery without sequelae. In 1921, I published the first series of 115 cases with the results of complement fixation of the spinal fluids by the use of my specific antigen. In mentioning the various symptoms encountered, I found neuroretinitis in 4 per cent of the cases. Since then, a series of more than 600 cases has maintained that percentage. I was interested in the report of one case with the Brown-Séquard syndrome, and of another with a positive Wassermann reaction. I think I have published two or three of these cases. One patient who gave a positive Wassermann reaction developed, after treatment with arsphenamine, a continuous myoclonus of the right arm and leg which lasted for three days and three nights. The complement fixation with my antigen was also positive, proving the presence of epidemic encephalitis; on administration of the horse serum the patient fully recovered. A later case at the Central Neurological Hospital was that of a woman with an apparent epidemic encephalitis, but also a positive Wassermann reaction. The complement fixation with my antigen gave negative results. The patient died and an autopsy was performed. I saw the slides only last week. They showed a syphilitic condition and were not of the epidemic encephalitic type. I do not see why a patient with syphilis cannot also have epidemic encephalitis. In the case with the Brown-Séquard syndrome, how was it discovered that he had epidemic encephalitis?

I wish the pathologic departments of the hospitals would avail themselves of the antigen which I have prepared and which is still being used with satisfaction. My results have been about 85 per cent positive. If the results were 100 per cent positive I should feel that there was something wrong with the laboratory. Another criterion for the diagnosis of epidemic encephalitis does not exist.

DR. J. W. STEPHENSON: The incidence of so many similar cases over the same period would suggest one classification, but I should be wary of calling them all undoubted cases of encephalitis. Sufficient time has not elapsed to prove that a few were not tumors of the brain. The mental cases possibly were frontal tumors. It is well known that frontal tumors frequently improve following lumbar puncture, choked disks subsiding in some cases. The acute onset does not exclude a diagnosis of tumor of the brain. A child at Bellevue Hospital suddenly developed fever, chills, headache and vomiting. Examination showed gross choking of the disk and signs referable to a lesion of the midbrain. Improvement followed a lumbar puncture and indicated encephalitis. For therapy, a lumbar puncture was done at regular intervals. In eight weeks, all the choking of the disks had disappeared. The patient left the hospital free from all symptoms, but twelve months later reappeared with the same picture, except the acute onset. The patient died and the postmortem examination showed a tumor of the midbrain. A question I should like to ask refers to a report made several years ago concerning the spinal fluid as a means of differentiating between tumor of the brain and encephalitis. The contention, which was corroborated in one of my own cases, was that in subsequent lumbar punctures in encephalitis an increased volume of the spinal fluid was found, whereas in tumors of the brain there was a diminished volume. Was this true of any of Dr. Rothenberg's cases?

DR. S. ROTHENBERG: I anticipated a discussion as to whether or not these cases were definitely encephalitic or whether they were something entirely different. The rapid onset and course of the symptoms which were identical in all of the first three cases, occurring within two months, indicated a different condition from what I had seen previously. In several hundred cases of encephalitis observed since 1918, I had never before seen so fulminating a type of optic neuritis as in the foregoing series. The ninth case, which I did not describe in full, was really the first case seen and was observed over a long period of time.

The patient originally had an attack of encephalitis which was diagnosed as such in a New York hospital, eight months before the case came to my attention. The patient suddenly developed an acute onset of ophthalmoplegia interna and externa which was soon followed by loss of vision. Optic observations were not made at first. Later, choked disks developed. The patient was seen by several physicians in Brooklyn and New York. The only diagnosis that seemed possible was a recurrent attack of epidemic encephalitis, with a peculiar and rare kind of symptomatology. The following case, the seventh in the series, was that of the man who at first showed a positive Wassermann reaction. The patient was irrational and developed a psychotic condition; then a loss of vision occurred, again without any optic symptoms. The case ran a rapid course with delirium and coma. It was impossible to make a diagnosis at that time. Meningitis did not seem to be present and the patient did not have an infection of the sinuses. An optic atrophy soon developed. Encephalitis seemed the only possible explanation for all the symptoms present. Then came the three cases first reported which occurred within the short period of two months. They showed a rapid, fulminating type of papilledema which cleared up within a short period of time. These cases were undoubtedly epidemic encephalitis. The patients had headache, mild lethargy, cranial nerve symptoms, diplopia, ptosis of the lid and all the symptoms of the ordinary type of encephalitis.

We did not avail ourselves of the serum or antigen of Dr. Neustaedter. Perhaps in the future, if I see cases of this kind again, I will do so.

ANXIETY AND FRIGHT: A BIOLOGIC AND PSYCHOLOGIC COMPARISON. DR. A. KARDINER (by invitation).

The psychologic comparison of the reactions of fright and anxiety is made on a psychoanalytic basis. Neurotic anxiety from this point of view is a highly organized reaction based on the anticipation of danger, and is attached to some idea or situation which is symbolic of a repressed idea. The emotion of anxiety is typically handled by such processes as conversion, displacement and symbolization.

The reaction of fright is a response to an overwhelming or unanticipated stimulus which completely disrupts the ego. Fright is the basic unit of the clinical syndromes created under conditions of warfare, war neuroses. The characteristic feature of these neuroses is that most of the symptoms come from disturbances in the relation of body-ego to external environment, a source which in the ordinary psychoneuroses is left more or less intact. The chief features of the neurosis are the absence of displacement phenomena, the somatic fixations and the stereotyped dream life. According to psychology, the instinctive disturbance lies in the ego and not in the sexual instincts. In the regression from the disturbance, patterns of adaptation are revived that are characteristic of the infant. The convulsive reaction is likewise patterned on fright.

Anxiety and fright are therefore basic units of two different types of clinical pictures. This thesis is not incompatible with the present status of the libido theory, as both ego and sexual instincts are representative of the erotic instincts in contrast with the "Todestriebe." The only difference between the two groups of instincts is that each has a different somatic reference, different methods of representation in consciousness, and hence result in different clinical pictures.

The traumatic neurosis is not devoid of libidinal components, but most of the symptomatology refers to egoistic disturbance.

DISCUSSION

DR. A. A. BRILL: As Dr. Kardiner read his paper, I doubted that everyone understood him. To understand its basic principle, one should not only be fully informed about the problem of anxiety, but one should also know Freud's more recent formulations of the instincts, as well as his effort to correlate with them the conditions of fright and anxiety. Formerly, one talked about the two primary instincts as hunger and love, or as self-preservation, to which Dr. Kardiner does not like to adhere, and the preservation of the species, and one said that everything

revolved around them. As Freud proceeded with his studies and gained new insight, he placed hunger and love together under the erotic or life instinct, and contrasting it, formulated the so-called death instinct, represented by sadism. In making this innovation, Freud made use of the works of experimental biologists such as Weismann, Woodruff and J. Loeb. According to these new points of view, which appeared first in his "Jenseits des Lustprinzips," life started accidentally as a unicellular organism in inorganic matter. As soon, however, as it was manifest, there was at once a tendency to pull it back to the inorganic. This tendency is found in every living being, for the individual is nothing but an aggregate of single cells. Ordinarily, the death instinct is neutralized by the muscular activity directed to the outer world; as long as the individual is young, the life or erotic instinct makes the greater appeal. The desire for peace, quiet and rest which characterizes elderly persons is an indication of the approaching victory of the death instinct. It is, however, in the neuroses that the struggle between the two instincts is best observed. Here the mixtures of the instincts are often disturbed and one noticed a preponderance of one or the other in the various phases of manic-depressive psychoses, the fainting spells of hysteria, the various forms of epilepsy, and in the perversion of sadism. Psychoanalysts were always puzzled about the behavior of patients with traumatic neurosis for it seemed inexplicable that a person who had had a severe accident would continue to reproduce it in his dreams. After all, the dream is supposed to remove the disturbing tension by deceiving the dreamer into the belief that his wishes have come true. The dreams of anxiety furnish the exception in that the dream fails to fulfil its function as the guardian of sleep. One says the dream cannot fulfil its function because some somatic or psychic situation arises which makes it impossible for the dream to deceive the subject into sleeping. Thus, a man will dream of drinking water when he is thirsty, but a man dreamed that he was extremely thirsty and made desperate efforts to get to the water, but awoke to find that he had a temperature of 104 F. The dream could not deceive the man into sleeping, because there was an element of danger. He had to awake to get some water; he could not be deluded into waiting until morning. The situation is more complicated in the dreams of traumatic neurotic patients which repeat scenes of the traumatic event. In these dreams an effort is made to gain control of the shocking stimuli by developing anxiety, the absence of which really caused the traumatic neurosis. The characteristic of anxiety is not only the expectation of danger, but preparation for it, whereas fright occurs when one is confronted with danger which is not prepared for. The element of surprise plays a great part here. Anxiety as such could really not produce a traumatic neurosis; it has a quality which protects against fright and fright neurosis.

As Dr. Kardiner stated, the study of anxiety received its greatest impetus from the study of the traumatic neuroses resulting from the war. The patients repeatedly experienced in their dreams the horrors which caused their neuroses. Freud observed that after children go through a disagreeable experience or an actual trauma, like a tonsillectomy, they often make a sort of game out of it. Following an operation, they often play doctor and repeatedly reproduce the painful experience. Freud concluded that this repetition is the effort of the child to master the disagreeable situation. It is an attempt on the part of the nervous system to assimilate an experience which did violence to the individual. These and other observations led Freud to assume the existence of a repetition-compulsion rather than the pleasure principle which was hitherto considered the *vis a tergo* of dreams and neurotic symptoms. I fully agree with Dr. Kardiner's observations on fright and anxiety. The statement which he attributed to me about the absence of pure anxiety neurosis was made about fifteen years ago and I have seen no reason to change it since then. From time to time I meet cases of anxiety which seem pure, but a little study always reveals an anxiety hysteria.

Dr. Kardiner has worked out this problem thoroughly. I do not know, however, that I would agree that the infant does not really experience anxiety. I always feel that the infant does experience an emotion which cannot be called

by any other name. Surely, until that particular period he was in that pleasurable narcissistic situation where there was no disturbance; suddenly he was thrown into many shocking situations. The infant cannot gage his reaction by anything. I agree with Dr. Kardiner that the sensorium of the infant is not yet fully developed, and that consequently one cannot assume that he feels it in our sense. It is a violent shock, however, and a disturbance which I believe cannot escape him, for as soon as it happens an effort is made by the environment to put him back again into the original situation, as much as possible. He is covered up, made comfortable and warm, and kept that way for days. I therefore believe that the trauma of birth is a model for later anxiety. I fully agree with Dr. Kardiner, however, that the importance attributed by Rank to the trauma of birth is markedly exaggerated.

Dr. C. P. Oberndorf: My experience with traumatic neurosis incidental to war has been limited. The actual occurrence of the reactions which Dr. Kardiner mentioned in his paper depends, almost entirely, I think, on whether the shock is sufficiently acute and intense to overwhelm the ego. I have seen, however, several apparently healthy people subjected to the strain of trauma. One was a young woman in London at the time of the raids of the Zeppelins. A bomb exploded near the house where she was living. After this accident the patient developed extreme anxiety, depression and inability to sleep. At that particular time the patient was experiencing a severe conflict with regard to her husband whom she had been forced to marry, against her wishes, while still in love with a young nobleman. It appeared that all the anxiety centered in this disturbing situation at the time of the raid and was displaced on the explosion of the bomb. I have seen a number of cases in civil life in which mild trauma has produced intense reactions; in each one of these cases there existed at the time an extreme degree of anxiety because of personal conflicts in the life of the individual. When the trauma is overwhelming, such as that occurring in battle, the ego is bound to defend itself in some way; possibly the only defense is playing dead. As Dr. Kardiner showed, recovery comes very gradually in these cases with the reintegration of the ego, and the patient becomes able to adjust himself. In the cases following minor trauma, symbolic representations and the symptoms of the true psychoneurotic patient develop more rapidly.

Dr. A. Kardiner: I did not undertake to give a completed or finished psychologic analysis of the traumatic neuroses, but attempted to define the nature of one of the most characteristic phases of traumatic neurosis. All the traumatic neuroses have libidinal components. Psychosexual conflicts are very common in them in male patients; I have not seen any female patients with this condition. In a large percentage of the traumatic cases, the conflict or the difficulty seems to be localized on these egoistic lines: A great deal of it is superimposed on a psychosexual conflict to produce the type of neurosis which Dr. Oberndorf has described. I do not term these cases traumatic neuroses. I do not believe the trauma has much to do with this type of neurosis, except that it acts as the last straw. It does not, however, contribute to the fabric of the neurosis. I do not consider that these are traumatic neuroses; I consider them psychoneuroses. The type of case that my considerations are based on is that in which the egoistic conflict dominates the picture.

I consider that all the phenomena of the psychoneuroses are repetitive. Repetitive phenomena are not recognized as readily in the psychoneuroses because they are subject to so many transformations through displacement. The repetitive mechanism is basic, although Freud's description in his paper "Jenseits des Lustprinzips" limits it to the traumatic neuroses. It is not. It is instead a universal character of psychic processes; it escapes our recognition in the psychoneuroses because there it is subject to so many transformations.

Dr. Brill's conception of the sado-masochistic dreams as evidence of the original and fundamental sadistic make-up, is, of course, the old view, particularly concerned with epilepsy. These people are arbitrarily described as being sadistic or inclined to masochistic outlet. I think, however, that this expression of sadism means that the normal sadistic outlets are blocked.

I cannot agree with any certainty that a new-born infant has anxiety. My argument was based entirely on certain analogies. The analogy of the new-born child with the soldier whose ego is disrupted by a trauma may be incorrect, but certainly the original expressions of the child do not resemble the reactions which are subsequently identified as those of anxiety.

CHICAGO NEUROLOGICAL SOCIETY

Regular Meeting, Oct. 18, 1928

LOYAL DAVIS, M.D., *President, in the Chair*

PRESENTATION OF PATHOLOGIC SPECIMENS. A CLINICOPATHOLOGIC REPORT. DR. T. T. STONE.

CASE 1.—*Spongioblastoma multiforme in the frontoparietal region.*

History.—Mrs. G., aged 48, a housewife, was admitted to the Illinois Masonic Hospital on April 21, 1928. On Feb. 28, 1928, she had complained of severe, generalized headache, which had started two weeks previously in a mild form and had increased in severity. On that date, a generalized convulsion occurred, with complete loss of consciousness, frothing at the mouth, rolling of the eyes in both directions, vomiting and turning of the head to the left. There was no history of defecation or urination during this attack, which lasted fifteen minutes. Two hours later, a similar seizure occurred which lasted for twelve minutes, and a third attack occurred late in the same evening. A fourth generalized convulsion occurred on March 2. Following this seizure, the patient remained in bed for three days, complaining of a mild headache on the left side over the frontoparietal region. At the end of three days, she tried to get up but found that she was extremely weak and returned to bed, where she remained for one month. At the end of that time she felt considerably improved; the headache was almost gone and she was stronger. She got up, but twenty-four hours later the headache on the left side became more severe. On April 19, she suddenly became dizzy and lay down on a couch; at first she appeared to be asleep but later went into a semicomatose condition. She could be aroused with difficulty. The following day she apparently was unable to understand commands or to talk. She moved her extremities and opened her eyes, but did not obey any commands. This condition progressed until the patient went into a deep coma and died on April 22.

The past history revealed that edema of the ankles had been present for several months prior to the onset of the headache and that the patient had had periods of absent mindedness, during which she was unable to remember what she had planned to do. There was nocturia on two or three occasions.

Neurologic Examination.—The patient was in coma and could not be aroused. The breathing was deep and stertorous. Sensation could not be tested. The deep reflexes, especially those in the upper and lower right extremities were markedly exaggerated. There were bilateral Babinski and Oppenheim signs. No abdominal reflexes or tonic neck reflexes were elicited. The pupils were equal and reacted sluggishly to light; accommodation could not be tested. The vessels of the fundi were sclerotic and tortuous. The disks were not swollen, and the margins were distinct. The blood pressure was 190 systolic, and 90 diastolic. Examinations of the blood and spinal fluid gave negative results. The urine showed a trace of albumin, with hyaline casts. The white count showed 16,800 leukocytes.

Anatomic Diagnosis.—The diagnosis was: cyst in the left hemisphere, extending from the precentral gyrus anteriorly to the left lateral ventricle mesially; cerebral arteriosclerosis, with calcification of the basilar artery; chronic degenerative myocarditis; atheromatous degeneration of the arch of the aorta; red hepatization of the lower lobe of the left lung and pleuritis.

Macroscopic Examination.—A mass, 4 by 2.5 cm., was found in the left frontoparietal region. It contained a mucoid gelatinous substance.

Microscopic Examination.—The mass consisted of true neoplastic, multinucleated giant cells, with a hyaline change of the cytoplasm; large numbers of mitotic figures were noted; the cells were of multiform type with variations in the types of nuclei. Cajal gold sublimate preparations revealed round, elongated, pear-shaped and spindle-shaped cells. Several imperfect astrocytes were seen. The vessels showed an overgrowth of the adventitia, and the sinuses were thin walled. The tissue surrounding the tumor also showed cellular changes.

The microscopic diagnosis was spongioblastoma multiforme.

CASE 2.—*Myelomalacia.*

Miss S. L., aged 26, a factory worker, was admitted to the Cook County Hospital on July 4, 1928, complaining of inability to walk, rectal and urinary incontinence and sensory disturbance. She had been well until May, 1928, when she had an attack of influenza; during this attack she had chills, fever, headaches and constipation, which lasted three days. At the end of that time she returned to work. About one week after the onset of the so-called "flu" she developed pain in the left hip and leg, and a few days later pain in the right lower extremity. Three weeks later, the left leg became paralyzed, but was painless. The paralysis gradually extended to the right leg and the upper extremities, and on entrance to the hospital she was completely paralyzed. There was nothing of importance in the past history.

The temperature was 99 F., the pulse rate 102 and the respiratory rate 24; the blood pressure was 126 systolic and 82 diastolic.

Neurologic Examination.—The patient was fully conscious and talked distinctly and intelligently. She was entirely unable to move the upper and lower extremities or the trunk. There was a tetraplegia of the flaccid type. Sensory examination revealed a thermanesthesia below the base of the neck, 2 cm. above the upper margin of the clavicle; tactile sensibility was not perceptible up to the level of the distribution of the fifth thoracic root on the left and the third thoracic root on the right. There was absence of sensation to pain up to 2 cm. below the navel on the left, and to 3 cm. above the navel on the right side. There was an ulcer on the back at the level of the tenth thoracic spine. The deep reflexes were absent in the lower extremities, but were present in the upper. The superficial reflexes were normal. Pathologic reflexes were not elicited. The cranial nerves were normal.

The blood, spinal fluid and urine were essentially normal.

The patient died on July 16, 1928.

Macroscopic Examination.—The entire spinal cord, from the lumbar to the cervical region, revealed areas of focal softening.

Microscopic Examination.—The areas of softening were made up entirely of gitter cells, with one or more nuclei. In the cervical region the softening process was found in the posterior, anterior and lateral columns. The blood vessels were distended and surrounded by a number of small hyperchromatic nuclei, with little cytoplasm. The gitter cell formation in this region was tremendous. The ganglion cells of the anterior horn were well preserved. No cellular exudate was seen in the meninges. The lower cervical region showed that these areas were more abundant and confluent, but none of these areas extended to the surface of the cord. The motor ganglion cells of the anterior horn showed degenerative changes. The middorsal region of the cord showed similar destructive changes of the posterolateral columns, with moderate hemorrhages in the anterior columns. The glia cells revealed proliferative changes, especially around the central canal. The lumbar cord showed the softening process in the posterior columns. The motor cells of the anterior horns were involved, but to a lesser degree than that found in the upper regions of the cord. There was increased capillary formation. The sections did not show any evidence of meningeal involvement. No fibroblasts or plasma cells were seen.

The microscopic diagnosis was myelomalacia, probably due to thrombosis of the spinal arteries.

DISCUSSION

DR. G. B. HASSIN: It is interesting to note how often myelitis is diagnosed when the condition actually present is softening of the cord. According to the statistics of Mager, about 85 per cent of the cases that are diagnosed clinically as myelitis are myelomalacia. Myelitis is rather rare; yet it is necessary to make a proper differential diagnosis, for myelitis, an inflammatory condition, gives a better prognosis than does myelomalacia, a degenerative condition. In this case the prognosis was bad because both motor and sensory symptoms progressed rapidly resulting in a clinical picture of Landry's paralysis.

DR. HUGH T. PATRICK: What Doctor Hassin said may well be emphasized a little more. As a matter of fact, acute myelitis is an extremely rare disease. This has been emphasized for many years. Bastian, in England, many years ago, Dejerine and others have emphasized it, and yet in this country acute conditions of the spinal cord are frequently diagnosed as myelitis.

DR. PERCIVAL BAILEY: The microscopic picture in case 1 is typical of spongioblastoma multiforme, except that there are more numerous giant cells than is usual in this disease. Whether that is the proper term to be applied to these tumors is questionable, because the cells are not properly spongioblasts. It would probably be better to apply a term such as glioblastoma rather than spongioblastoma. There is some evidence that these tumors arise from the dedifferentiation of the protoplasmic cells in the cortex. I have seen several cases in which an operation has been performed and a typical protoplasmic astrocytoma found; when the patients were operated on again a year or so later a typical spongioblastoma multiforme was revealed.

NERVE ENDINGS IN THE CHOROID PLEXUS OF THE FOURTH VENTRICLE. DR. S. L. CLARK.

The choroid plexuses of the fourth ventricle of the cat, dog, rabbit and rat have been studied for nerve endings. Intact brains and separate plexuses were prepared by the pyridine-silver method and sectioned serially. In the connective tissue of the lateral tufts of the choroid plexus, endings were observed of types similar to those described by Stöhr for the pia mater. These endings were supplied by a nerve bundle which arose from the dorsolateral region of the medulla.

In the medial tufts of the choroid plexus the only type of nerve ending observed was that in relation to epithelium. These were bare nerve endings arising from large myelinated fibers which could be traced from the medulla via the taenia of the fourth ventricle.

Though nerve fibers and endings were observed on those blood vessels that possessed smooth muscle, endings were not seen on capillaries. Ganglion cells were not observed on blood vessels or in the choroid plexus.

The complete text of this paper is to appear in the *Journal of Comparative Neurology*.

DISCUSSION

DR. G. B. HASSIN: In my studies of the nerve supply of the blood vessels of the brain I also became interested in the nerve supply of the choroid plexus. I used the silver staining method of Schultze as used by Stöhr in similar studies. It is an easy method and gives beautiful pictures. I used brains of human beings, mainly of infants, and also brains of adult animals. The pia and the choroid plexus of the third and fourth ventricles were not sectioned but stained in toto. The choroidal tela shows an abundance of nerve fibers, supplied partly by the tenth and partly by the sympathetic nerve. It was possible to follow their course, but I could not determine the mode of their endings. Stöhr did not come to any definite conclusions either. He postulates that, in view of the fact that the third and fourth ventricles possess an enormous number of nerve fibers, these must

have some effect on the cerebrospinal fluid. As many fibers are vascular, they must dominate the circulation of the blood, and this in its turn must affect the spinal fluid.

Some Correlations Between the Development of the Spinal Gray Matter and the Behavior Pattern in the Cat. Dr. William F. Windle.

In the gray matter of the spinal columns of new-born and very young kittens, the collaterals of axons run parallel to the dendron of the anterior horn cells and are not continuous with the dendrons. This apposition of nerve fibers in the gray matter is the only visible mechanism for synapsis in animals younger than 30 days. In pyridine-silver preparations of the spinal cord of adult cats, pericellular plexuses of fine unmyelinated nerve fibers, which terminate in bulbs, knobs or loops on the cell bodies and dendrons, may be easily observed. It is possible that this apparent mechanism supplements the one of parallel apposition in the older animals. The end-bulbs of the pericellular plexuses first appear in animals 1 month old, gradually increasing in number during the next twenty to thirty days until they become as numerous as in the cord of the adult. Before the end-bulbs appear there is a marked increase in the number of fine unmyelinated nerve fibers of the gray matter. This occurs about 20 days after birth. The fibers, which run in all directions in the gray matter and the courses of which are extremely tortuous, seem to arise, at least in part, from collaterals of axons from the ground bundles of the cord.

Coincident with the enrichment of the gray matter by fine unmyelinated fibers, the kitten, which has previously been quite helpless, learns to stand, sit and walk. Coincident with the appearance of end-bulbs and true pericellular plexuses the animal shows marked improvement in integration and synergy, as is evident by the acquisition of the ability to back away, to run, to paw playfully and to climb.

During the course of an attempt to determine microscopically the developmental changes which take place in the brain stem and spinal cord of young kittens at the time of appearance of decerebrate rigidity reported by Weed and Langworthy, several new-born and very young animals were prepared by the method of Sherrington. Extensor rigidity was observed to be present at birth in all legs, but was most marked in the forelegs. Development of rigidity seems to depend on the level at which the section has been made. When the brain stem is sectioned from the superior colliculi dorsally to the anterior border of the pons ventrally, true rigidity results, and the animal fails to execute prolonged progressive movements. When the section passes from the superior colliculi dorsally to a point just behind the optic chiasma ventrally, the animal is able to right itself and execute prolonged alternate progressive movements. It behaves quite like the litter mates on which operation has not been performed, but rigidity may appear in the intervals between periods of activity. This is in accord with the observations of Hinsey and Ranson on the adult cat.

DISCUSSION

Dr. S. W. Ranson: A great deal of work is being done on the subject of correlation of the development of structure and function in the nervous system. The idea originated with Dr. Coghill of the University of Kansas, who is now at Wistar Institute, where this is becoming the major line of research. He is working with the white rat and has confined his studies almost exclusively to fetal stages of development. Dr. Windle has shown the many interesting things to be learned about the development of the gray matter of the spinal column from the period of birth on to functional maturity.

I am much interested in the second part of Dr. Windle's paper. As he indicated, Dr. Hinsey and I have been working with decerebrate cats, making studies of the crossed extension reflexes in animals decerebrated at different levels. A number of times we had extremely restless cats which we could not hold down, and we always felt much chagrined when the decerebration resulted in this way.

One day I was trying to hold one of them on the table when it definitely tried to get on its feet. I put it on the floor and held it by the tail, supporting it slightly, and it began to walk away. Within thirty minutes, it was walking by itself. It walked across the room and hit its head against the wall, turned around and then walked back, covering a distance of 15 feet before it fell. We put up an upright wire frame covered with muslin, and it climbed up this a distance of 3 feet almost vertically. In walking there was a slight tendency to stagger, but the gait was fairly good. We found at autopsy that the section had passed from the upper border of the superior colliculus to the optic chiasma. We later had two more of these walking cats with transections at approximately that level. When the section is made a little further back, at the upper border of the mesencephalon, we obtained an entirely different picture, the typical picture of decerebrate rigidity. So that evidently in that little triangular portion of brain substance which lies between the two levels of section, and which is not more than 3 mm. thick, there lie some important centers which control locomotion and inhibit decerebrate rigidity. Rademaker and Magnus stated that the red nucleus is responsible for the regulation of tonus, and when the red nucleus is intact the distribution of tonus in the flexors and extensors is normal. Rademaker's protocols show that he obtained rigidity in 50 per cent of the cats decerebrated at the upper level of the mesencephalon. In the rabbit, that same level of decerebration regularly gives a normal distribution of tonus. It is not known just what nuclei are involved in the regulation of tonus and in the control of locomotion, but one can list the nuclei which are included in the triangular portion of the hypothalamus, the removal of which prevents a cat from walking. These are the upper level of the red nucleus, the subthalamic nucleus and the two hypothalamic nuclei.

PHILADELPHIA NEUROLOGICAL SOCIETY

Regular Meeting, Oct. 26, 1928

N. W. WINKELMAN, M.D., *President, in the Chair*

A CASE OF MULTIPLE NEURITIS ASSOCIATED WITH THE TOXEMIA OF PREGNANCY AND THE POSSIBLE INFLUENCE OF RETAINED FETAL PRODUCTS. DR. C. A. PATTEN.

This case is being reported because of the infrequency of multiple neuritis associated with pregnancy, and the difficulty in determining an exact etiologic diagnosis. The patient, a woman, aged 22, with a normal menstrual and past medical history, was admitted to the Philadelphia Lying-in Hospital on July 3, 1928, with a history of persistent nausea and vomiting for three months. She had lost 45 pounds (20.4 Kg.) in weight, and had been unable to retain nourishment for several days before admission to the hospital. A vaginal examination indicated a pregnancy of about four months, but failed to show any evidence of a pathologic process. For an indefinite period prior to admission the patient had been mentally confused and partially disoriented. The obstetrician decided that it would be impossible for her to continue with the pregnancy, and five days after her admission, under nitrous oxide anesthesia, he dilated the cervix, ruptured the membranes, removed some placental tissue and packed the lower uterine segment with gauze.

She had been exhibiting a continuous fever, but following the operation the temperature dropped slightly, though it continued above normal for a period of about ten days. The gauze was removed at the end of forty-eight hours; shortly after, it was reported that some fetal parts had been expelled. She had a foul vaginal discharge, and was treated for this condition by daily vaginal douches. The general treatment consisted of a semi-Fowler position, ice packs, ergot and forced nourishment. During her entire stay in the hospital she was markedly confused mentally, and required the services of a special nurse. It was reported

by the nurse that the patient, from the time of her admission, complained bitterly of marked tenderness when the arms or legs were touched or bathed.

She was discharged from the hospital and I was called to see her when she had been at home for a few days, because of her mental condition. I found the patient markedly emaciated, extremely toxic in appearance, more or less disoriented, unable to give any history of her condition, and frequently stating in reply to questions, "I cannot remember." She was partially disoriented, did not show any interest in her surroundings, and complained bitterly of intense pains in her arms and legs. The neurologic examination showed a normal condition of the cranial nerves, but a definite peripheral multiple neuritis, with marked wasting of muscles, absence of tendon reflexes, exquisite tenderness in the lower extremities on touch or pressure and less marked tenderness in the upper extremities. There were indefinite sensory changes, most marked at the distal portions of the extremities and shading off into fairly normal areas as the proximal segments were approached. She had bilateral foot drop, but no wrist drop. Her temperature was normal. The family stated that the patient was unable to sleep because of pain, and that she was particularly confused at night, having to be watched constantly.

Because of the difficulty in caring for her at home, she was admitted to the Graduate Hospital for more thorough study and treatment. Complete examination in the hospital failed to reveal any evidence of focal infection, except that pus could be expressed from one of the tonsils. The blood count on the day of admission showed a leukocytosis of 10,300; the urine showed a trace of albumin; the Wassermann reaction of the blood was negative; the spinal fluid was normal, except for a colloidal gold curve of 1122332100. Chemical examination of the blood gave practically negative results. She had a foul vaginal discharge, with considerable mixture of blood, and it was thought at the time that she might be menstruating. She was referred for examination to the gynecologist who found a mass containing fetal products in the vagina. The mass was removed and appropriate after-treatment instituted. After this the patient's mental symptoms cleared up rather quickly, and the peripheral neuritis began to improve.

The progress toward recovery has been steady and satisfactory up to the present time. All pains have ceased, and there now remains only slight tenderness of the feet. Muscle power has improved generally, and the foot drop is much less marked than formerly. The further and more marked improvement following complete removal of all fetal products places considerable blame on the presence of the fetus. I have no doubt but that the sapremia accompanying the vaginal retention of fetal products added considerably to the toxemia and intensified the symptoms. The dead fetus, however, was not the cause of the multiple neuritis, as there is definite historical evidence to show that she had pain and tenderness prior to the therapeutic abortion. One must fall back then on the pregnancy and possible disturbances in metabolism for the etiology.

The question of the etiologic factors in the production of the mental disorders and multiple neuritis in pregnancy is of considerable speculative interest. In this case, the fact that both conditions occurred during the course of an early pregnancy associated with pernicious nausea and vomiting, strongly suggests that the pregnancy was the basic cause. Whether one ascribes this condition to a syncytiotoxic or nephrotoxic theory of toxemia of pregnancy depends perhaps on his experiences. The fact remains, however, as exemplified by this case, that it is capable of producing a severe multiple neuritis. Eulenberg collected a number of cases of neuritis in pregnancy, and I dare say there have been many unreported cases.

The main point of interest from the neurologic standpoint and the practical aspect of the subject is whether or not multiple neuritis occurring during pregnancy, and resembling in every manner the toxic type of multiple neuritis in the nonpregnant woman, can be produced by the products of disordered metabolism, by some toxic agent elaborated by the fetus, or by the disturbed function of such organs as the kidneys, liver, etc. Many obstetricians, I believe, are definitely leaning toward the theory of a disturbance of endocrine function to explain the

situation. In the present instance, no evidence is obtainable of disease of any organ or tissue except the negligible infection of one tonsil. The factors producing the multiple neuritis were operative during the presence of a fetus, and ceased activity as soon as the uterus and vagina were emptied. It is fair to assume then that the fetus was the primary cause of the toxemia, the confusional psychosis and the multiple neuritis.

DISCUSSION

DR. GEORGE WILSON: Had she been taking any tonics before this?

DR. C. A. PATTEN: The patient was totally unable to retain even liquids by mouth for some time prior to admission to the Lying-in Hospital, and it is my understanding that she was gravely ill at that time.

DR. N. W. WINKELMAN: Were there any skin eruptions on the wrists?

DR. C. A. PATTEN: She has had considerable acne on the face for a number of years, but at no time have I observed any eruptions on the upper or lower extremities.

DR. N. W. WINKELMAN: One other point — is this an atypical form of pellagra? It does not necessarily have to be a lesion of the spinal cord. Was it not more the feeding of the patient?

DR. C. A. PATTEN: If my memory serves me correctly, Dr. Winkelman, in a paper with Dr. Klauder, stated that pellagra was due to alcoholism. There is no such history in this case.

DR. GEORGE WILSON: That is what I had in mind when I asked if she had been taking tonics.

DR. C. A. PATTEN: An interesting feature of the case is the somewhat marked resemblance to Korsakoff's psychosis, although lacking the typical confabulations.

REFLEX GRASPING AND GROPING: ITS SIGNIFICANCE IN CEREBRAL LOCALIZATION. DR. WALTER FREEMAN and DR. P. T. CROSBY, U. S. N.

The reflex grasping produced in the infant by introducing the finger into its palm is a phenomenon too well known to deserve description. It disappears as the child develops, probably about the age of 1 year, although the exact time is variable. This phenomenon may appear in later life as a manifestation of disease of the brain, either focal or general. In certain cases it is of definite value, pointing accurately to the contralateral frontal lobe.

The sign is evoked by friction against the palm and thenar eminence with traction against the fingers. In certain cases, patients will complain of inability to release an object once it has been grasped. Occasionally, the grasping is associated with involuntary groping and with disturbances in the feeding mechanism.

The sign is found in transient and terminal states of unconsciousness with muscular hypertonus, when it is bilateral and has no special diagnostic significance. In conscious persons it may be unilateral or bilateral, and then indicates focal lesions. The sign is incompatible with gross hemiplegia, although there may be reflex grasping in the hand with paralysis of the lower extremity.

Five cases are selected from a much larger material, four of them being followed by necropsy reports. In all cases the major lesions were encountered in the frontal lobes.

THE INFLUENCE OF IRRADIATION UPON THE PREGNANT UTERUS AND GROWING EMBRYO. DR. DOUGLAS P. MURPHY.

Six hundred and twenty-five pregnancies in women subjected to radium or roentgen irradiation of the pelvis form the basis for the present study. The records of these pregnancies were secured from the current medical literature and in response to a questionnaire sent to leading gynecologists and radiologists throughout the United States.

In the two accompanying tables are shown the nature and frequency of the gross structural deformities observed in the full-term children born of these

irradiated women. The reports are grouped according to whether the maternal irradiation preceded or followed conception, this time element being the most important point to be considered in this study.

The great frequency of gross structural abnormalities among the children irradiated while in utero, and the uniformity ot the lesions appearing to involve chiefly the central nervous system would seem to indicate that there was a definite relationship between the embryonic irradiation and the lack of development of these children.

DISCUSSION

DR. J. HENDRIE LLOYD: I have not had any personal experience with this subject. Dr. Murphy's method has been scientific. He has not been aiming to prove a theory, but he has sought to collect facts and to draw proper inferences from them. The subject is perhaps of more direct practical interest to gynecologists and obstetricians, who use x-rays and radium about the female pelvic organs, but it is of scientific interest to neurologists and psychiatrists, because if x-rays and radium can thus affect the brain of the embryo, we certainly want to know it.

TABLE 1.—*Preconception Irradiation*

Full-term pregnancies		402
Deformed children		7 (1.7 per cent)
Deformities:		
Microcephaly	1	
Anencephaly	1	
Parietal bone ossification defects	1	
Deformity (no description)	1	
Congenital heart lesion	1	
Congenital tracheal stenosis	1	
No right forearm or right thumb (mother an idiot)	1	

TABLE 2.—*Postconception Irradiation*

Full-term pregnancies		74
Deformed children		25 (33.7 per cent)
Deformities:		
Microcephaly	17	
Hydrocephalus	2	
Mongolism	1	
Blind and underweight	1	
Malformation of head	1	
Deformed upper extremities	1	
Spina bifida and double club feet	1	
Divergent squint	1	

The cause of microcephaly has always been obscure, even unknown. It does not help much to say that it is due to heredity, or to a bad ancestral stock. Causes acting in the environment are probably more potent than heredity. I have thought of syphilis as a cause, but I do not recall having seen or heard of any scientific observations that prove this. Syphilis, of course, causes disease in the fetus — the well known congenital syphilis — but this is not microcephaly. One theory has been that microcephaly is a reversion or a "throw-back" to a more primitive or simian type. The brain of the monkey, however, is a normal brain and answers all the monkey's purposes; the brain of the microcephalic idiot, on the other hand, is a human brain which has been wrecked, spoiled in the making, and there is nothing monkey-like about it. Another theory has been that microcephaly is caused by a tight or nonexpanding amniotic sac during the seventh or eighth week of gestation, which prevented the growth of the embryo, deformed it and caused the head to be bent too far forward, interfering with the development of the structures at the base of the brain; but this seems like a rather fanciful theory.

What is microcephaly? Two English observers, Brushfield and Wyatt, have recently published a paper based on the postmortem examination and microscopic

study of ten microcephalic brains. They found that in every case the meninges showed chronic inflammatory changes. The dura was thickened and adherent to the pia-arachnoid; the leptomeninges were thickened and opaque, with a gelatinous exudate, especially around the sylvian fissure at the base. The vessels of the pia were intensely injected and involved in an inflammation. There was hypoplasia or paucity of neurons, often following the distribution of the middle cerebral artery, and in the precentral gyri areas almost devoid of large pyramidal cells occurred. In one case there was increase of neuroglia with formation of whorls (as seen in Friedreich's ataxia), also hydrocephalus, porencephaly, occlusion of vessels and thickening of the ependyma, along with great deformity and arrest of development of the cerebral hemispheres. All this indicates a destructive process, and there must be some cause for it. Those cases were not caused by x-rays and the authors quoted do not attempt to explain causation. There are probably more causes than one, because microcephaly was known long before the use of x-rays and radium; but if Dr. Murphy has shown that x-rays or radium is at least one cause, he has advanced our knowledge just one step. He has put the subject on a scientific basis, and has given us some clear light on an obscure problem.

DR. PANCOAST: Previous knowledge of some essential facts in Dr. Murphy's paper has led me to give considerable thought, as a roentgenologist, to some important and hitherto little known or understood possibilities. There was one point in the paper with which I was not familiar and which needs comment. I understood him to say in one of his closing sentences, "the woman should not be irradiated during early pregnancy." It is by no means possible to know always that a woman is in an early stage of pregnancy when irradiation may be necessary for some purpose, and there are many women who must be irradiated during the early months of pregnancy even though the fact be known.

It would seem that any undesirable effect on the offspring by irradiation is most likely to occur during the early months of pregnancy. Two therapeutic methods of irradiation must be considered; that by radium and that by roentgen rays. If one is going to consider dangers in connection with subsequent pregnancies, these dangers must be carefully weighed and the effects from the use of radium and x-rays must be compared, in order to select the one likely to do the necessary work and at the same time be the least harmful. Radium acts more locally in the treatment of conditions of the uterus. The x-rays exert their influence chiefly through the ovaries, mainly by sterilization. Gynecologists believe that, if it is necessary to bring about sterility in a younger woman, they had best use radium irradiation as much as possible, so that the patient may possibly recover the function. X-rays have more effect on the ovaries, and recovery may not be so likely, especially as there is not the same nicety of control.

It would seem that any undesirable effect on the offspring by irradiation occurs mostly during the early months of pregnancy. Many women who are just pregnant must be treated, and some become pregnant during treatment, which may take many months. It would seem advisable, therefore, to find out whether a woman is pregnant or not before starting treatment and to act accordingly. If she is pregnant at the time the treatment is started or becomes pregnant during the course, is it highly essential to terminate the pregnancy? I have at the present time, under treatment for a malignant condition of the pelvis, a woman who has become pregnant during the treatment. What should I advise the woman or her physician to do? In the light of what we have heard it would seem advisable to terminate this pregnancy. The patient will probably recover from the condition for which she is being treated, but treatment has been imperative. If one allows her to go to term, she may give birth to a living child which later may present evidences of idiocy. In the light of Dr. Murphy's investigations, a termination of pregnancy seems advisable in all such instances.

There are a number of patients with carcinoma of the cervix uteri who have been and in the future must be treated for the condition during pregnancy. It will not be necessary to adopt more or less fixed rules governing the procedure according to the relation between the stage of the disease and the period of preg-

nancy. There would probably be such groups as the following: (1) early carcinoma with early pregnancy, in which case the logical procedure would be to treat the woman in an attempt to save her, but also to terminate pregnancy; (2) early carcinoma and late pregnancy; (3) late carcinoma and early pregnancy; (4) late carcinoma and late pregnancy. Then there would always be borderline cases which would be difficult to fit into any one of these groups.

An important decision must be reached in connection with the diagnostic application of x-rays. Examinations of the gastro-intestinal tract probably necessitates more exposure than any others. The question arises as to whether one must be careful to determine whether or not every woman is pregnant before making such an examination. This would be a most difficult problem. So far as I have been able to note, no woman has ever ceased menstruation following a diagnostic examination of this kind, and I do not believe that a gastro-intestinal examination would be a danger. If it is, I want to know about it. I feel that an examination of the urinary tract is not dangerous in early pregnancy. These matters must be carefully studied.

RADICULITIS OR TUMOR OF THE SPINAL CORD? DR. H. M. GALBRAITH.

H. M., a man, aged 37, married, a steam fitter, complained of pain, wasting and weakness in the right leg. His family history was entirely without significance. His past history was unimportant except that five years before presentation he injured the right knee. There was rapid recovery, but he believed that since that time he has had a tendency to slap the right foot harder against the pavement than before. The patient has always had highly arched feet.

There were no symptoms until one month before admission to the hospital, when he sprained his right ankle. Three days later, he became soaked in a rain. That night, in bed, he noticed a steady aching pain, localized on the lateral aspect of the right leg just above the ankle. The area was about 3 by 4 inches in size and was tender to touch. The pain continued, becoming less in the morning but worse later in the day as the leg tired. After three or four days of this, a distinct weakness in the whole leg became noticeable. At the end of a week, the right leg was noticed to be smaller than the left. At about the same time, spells of sharp shooting pains, lasting as long as twenty minutes, appeared. The pains began in the tender area and radiated upward along the lateral and posterior surfaces of the leg and thigh to the hip, and back again. These spells, occurring at first only near the end of the day, increased gradually in severity and frequency until just before admission to the hospital, when the pain was agonizing and appeared several times a day. Three days before admission, after an unusually severe attack, the patient went to bed, stopping work entirely. With rest, the shooting pains have become much less frequent and severe, but the aching pain has persisted. Sudden movements, such as coughing, laughing, etc., have resulted in shooting pains down both legs. The aching pains have been relieved by lying on the left side and increased by lying on the abdomen. Numbness of all of the right toes has been noted since the onset of pain, but the patient has noted no other sensory changes, and disturbances of the bowel, bladder or sexual functions have not occurred.

On admission, a general physical examination revealed only marked pyorrhea. A neurologic examination showed no abnormalities above the first lumbar segment. The gait showed a marked limp, but nothing else. There was no incoordination of movements. There was well marked atrophy and weakness of the whole right leg and of both gluteal muscles. The atrophy was most marked in the right peroneal group of muscles. There were fibrillary tremors in all muscles of the right leg, of both gluteals and of the calf muscles of the left leg. There was well marked pes cavus on both sides, but this was much more pronounced in the right foot. The right toes were held in dorsal flexion. The achilles jerk on the right foot was decreased and the cremasteric reflex was increased. Tactile, pain and temperature sensibility were decreased over the right peroneal region, but there was no

sensory disturbance elsewhere. There was definite tenderness over the right external peroneal nerve. Results of Babinski and Romberg tests were negative.

Laboratory tests, including urine, blood counts, blood chemistry, Wassermann tests of the blood and spinal fluid and basal metabolism, were all negative. A lumbar puncture with a Queckenstedt test revealed normal pressure readings.

The probable diagnosis in this case is a lumbosacral radiculitis, more advanced on the right side than on the left.

BILATERAL EIGHTH NERVE SYPHILIS. UNILATERAL SEVENTH AND EIGHTH SYPHILIS. DR. GEORGE WILSON and DR. HAROLD GOODSPEED.

To be published in full elsewhere.

THE NEUROLOGICAL COMPLICATIONS OF PREGNANCY AND THE PUERPERIUM. DR. B. J. ALPERS and DR. H. D. PALMER.

To be published in full elsewhere.

Book Reviews

VAGOTONIES, SYMPATHICOTONIES, NEUROTONIES: LES ÉTATS DE DÉSÉQUILIBRE DU SYSTÈME NERVEUX ORGANOVEGETATIF. By A. C. GUILLAUME. Second edition. Price, 40 francs. Pp. 555. Paris: Masson & Cie, 1928.

It is not usual with American medical writers to engage in rather lengthy and close discussion with those of one's antagonists and critics who are averse to accepting our theses and theories, in a volume that otherwise is clearcut, definite and easily readable. Such discussions and arguments might well be relegated to an appendix and left out of the body of the volume. Among those who have criticized both generally and specifically the idea of vagotonia and sympathicotonia, to say nothing of the author's pet "neurotonias," are such as Cannon and G. Soderbergh. Nothing loath, our author cites Titus Livius, translated into French: "Il y a des époques, des hommes, et des événements, sur lesquels l'histoire seule peut porter un jugement définitif; les contemporaires et les témoins oculaires ne doivent écrire que ce qu'ils ont vu et entendu. Le vérité même le demande." And so almost blithely he disposes of his contemporaries!

But for real value Guillaume has given us a 555 page volume on the vegetative nervous system which is excellent in many ways. He first explains at length his conception of vagotonia and sympathicotonia and then adds what seems a rational addition, namely, "neurotonia" to this duality. By neurotonia he assures us is meant that condition in which both vagus and sympathetic systems are abnormal; either hypernormal or hyponormal; either simultaneous or alternative. Eppinger and Hess had considered that one of the two systems was always at a normal level while the balancing one was over or under excitable. So that for Guillaume, the classification of abnormal vegetative states would be as follows: (1) A hypertonic state of either one or the other of the antagonistic systems known as sympathicotonia, or vagotonia. (2) A hypotonic state of either one or the other system, transformed clinically in the domain where both systems are engaged, as a hypertonic condition of the antagonist; hence, again, clinically seen as a performance of the dominant system — and again a sympathicotonia or a vagotonia. (3) A condition of irregularity or dystonia of both systems, either at the same time in one individual (neurotonie intriguée) or vagotonic and sympathicotonic modalities alternating as to time in the same individual (neurotonie alternatif), which come under his classification of neurotonia. This classification connotes a pronounced difference from that originally proposed by Eppinger and Hess, whose "vagotonia" was really "neurotonie intriguée" with vagus predominance.

For those readers who have followed the development of knowledge or near knowledge of the vegetative nervous system in the past years, it will be a pleasure to read a few hundred pages of moderately easy French in watching Guillaume unfold his symptomatology, his description of syndromes, his critical dissection of criticisms of his theories, his physiologic conceptions as applied to a multitude of physical signs and conditions affecting other organs and tissues of the body, notably the nervous system at psychic and behavioristic levels; from capillaroscopy through visceral pathologic changes and endocrine involvement with all its vagaries up to the psychoneuroses and psychoses. "Is it necessary," asks Guillaume, "to make great distinctions between the various psychoneuroses?" and gives at least twenty different terms used by different authors over the world endeavoring to convey by them different syndromes which Guillaume thinks merge into one finally. "Or is it necessary to add any more terms or any further words to these?" They vary from "hypochondrie," "neurose-cérébro-cardique" and "neurose-psycho-splanchnique-cérébro-viscerale" to plain hysteria. He recognizes Beard's "American disease" — neurasthenia — but states emphatically that others than Americans are afflicted therewith, and that it really was known on the continent of Europe long before Beard's time.

For those, on the other hand, who are only mildly interested in the vegetative system and who have not kept up with the advances in this subject, the reading of this volume will prove trying and time consuming, for much is taken for granted as a background to its perusal and understanding.

The make-up of the volume in general is good; the bibliography of thirty finely printed pages is excellent, with credit and reference given impartially to outlanders as well as to Frenchmen. Only one signal failure is to be commented on: the lack of a table of contents or of an index is felt at every turn. Each page needs often an explanation to be found elsewhere in the book, and only after careful search, page after page, can it be found if at all. If this were remedied, the volume would be almost a necessity to the student of the vegetative nervous system.

RÊVES ET HALLUCINATIONS. By DR. SCHATZMANN. Paper. Price, 20 francs. Pp. 329. Paris: Vigot Frères, 1925.

In this book the author presents details of 128 dreams of his own, selected from a rich store of records covering many years. Of himself, he says that he has been an architect and later a physician; he has also suffered for many years from a form of arthritis with many subacute exacerbations and a great deal of suffering. Though he calls himself "a common-place man" he recognizes the fact that he has been of nervous temperament; yet he has found evidences of similarities in the dreams of others whom he has questioned, and he quotes at some length from other authors who have described dreams. He says that he has been interested always in dreams and that since the age of 6 he has had the idea of writing about them. Having, since early childhood, experienced one or more dreams every night, he estimates that he has had at least 20,000, and he remembers vividly innumerable examples.

While the author makes no claim to a solution of the problem of dreams, his studies have led him to a definite conclusion that dreams follow the same rules as thoughts and are made up of the same material. He does not find any justification for regarding them as more symbolic than ordinary thinking and believes that a complete knowledge of the train of thought and of the facts in the surroundings will furnish an adequate interpretation of the dream. The dreams of war time differ markedly from those of peace. He says: "I am inclined to believe that in our minds there exist, more or less mixed, three things: thoughts, images and dreams. Thoughts are present, in pure form at least, in the mind awake. Images, often independently of the will, dance before our senses in the state of foresleep, while thoughts and hypnagogic images form the framework of dreaming just as thoughts and thought images form the framework of conscious life. There would then be a difference between the dream and reality; something more—the fictitious images—and something less—the images perceived during the day which only rarely have a place in the dream of the succeeding night."

Dr. Schatzmann describes numerous hypnagogic hallucinations of his own, the occurrence of which he is inclined to attribute largely to intoxication in connection with his arthritis. He differentiates between these hallucinations and dreams much as he does between sensory images and thinking. He says of them "Possibly hypnagogic images occur only in those who are intoxicated: alimentary, gouty, rheumatic and diasthetic states in general. . . . Dreams, on the other hand, appear to be an absolutely healthy and normal psychic manifestation, merely nourished more richly in those with some intoxication."

The book is interestingly written, and its chief value lies in the presentation of a mass of data. It is somewhat difficult to follow the aim of the writer in classifying his material, but the book is never dull and makes use of an extensive literature.

THE DEVELOPMENT OF THE HUMAN EYE. By IDA C. MANN, M.B., B.S., F.R.C.S. Pp. 301. Cambridge, England: University Press, 1928.

The embryology of the human eye has been dealt with more or less superficially in the past. This work by Dr. Mann, which is thoroughly handled as are her other studies, will clear some of the vague points on this particular subject. The book is divided into different stages, beginning with the primary optic vesicle, and then takes the development through to that of the orbit and its contents. At the end of each chapter the author deals with many abnormalities in the development of the eye.

The most interesting division from a neurologic standpoint is that which deals with the neural ectoderm. Here she traces the development of the path from the inner or nerve fiber layer of the optic cup to the brain. In this particular chapter, Dr. Mann shows the early development of Müller's fibers and proves that these supporting fibers are among the first to make their appearance, showing conclusively that the more highly specialized fibers are practically, if not wholly, dependent on the development of Müller's fibers.

The author also noted that there was no medullation until after the fifth month, and that they first appeared along the optic tract and extended forward to the lamina cribrosa. The medullation appears as minute droplets of lecithin containing substance in the protoplasm of the glial cell. These droplets eventually run together and surround the axis cylinder.

The work entailed in this collaboration has been enormous. The references date back as far as 1751; some of them, however, are rather incomplete. Dr. Mann is to be complimented, for the book will be invaluable to the embryologist and pathologist.

SPASMOPHILIA. By EDWARD C. WHIGHTSMAN, M.D. Price, $2. Pp. 155, with 23 illustrations. Boston: Richard G. Badger, 1928.

The subject of spasmophilia has been attracting increased attention in the last decade. The author states that spasmophilia is a condition that usually accompanies rickets. He first discusses rickets, then devotes forty-one pages to a discussion of spasmophilia which he describes as a condition in which increased electrical and mechanical excitability is found. He states that bottle-fed babies are practically the only ones affected. As a causative factor he mentions the factors which produce rickets; more specifically, he attributes the condition to a lack of calcium and phosphate salts. He then describes the various types of spasmophilia, such as latent tetany, laryngospasm, general convulsions, tonic muscle spasms, bronchotetany and gastrotetany.

Later he discusses the differential diagnosis and finally treatment, in which he advocates giving calcium and parathyroid with the general hygienic conditions which are employed in rickets. The rest of the book discusses infant feeding.

The book is obviously intended more for pediatricians than for neurologists. While it has substance it is poorly constructed. The subject of spasmophilia itself could have been handled better in half the pages used in this volume. The author adds nothing new of scientific interest, but he contributes many facts from his experience which are valuable.

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